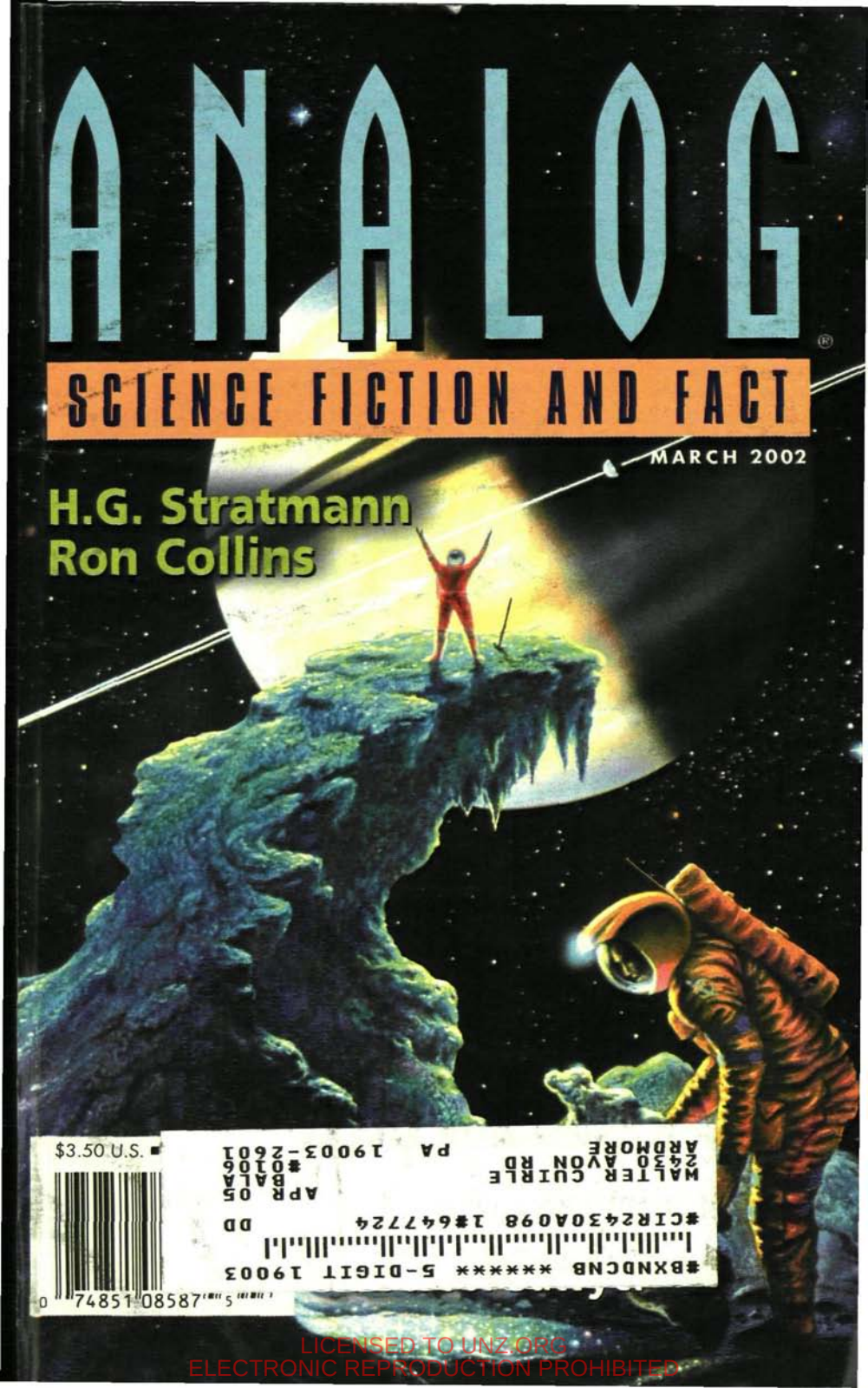

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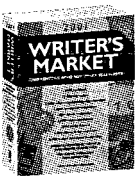

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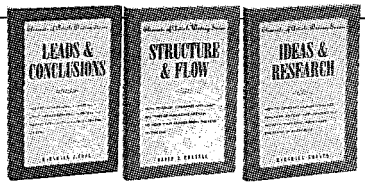

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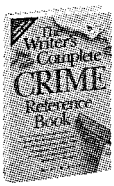

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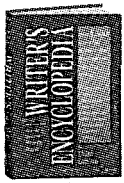

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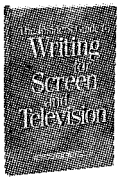

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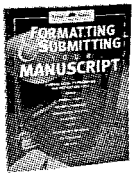

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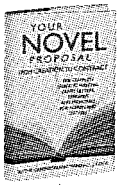

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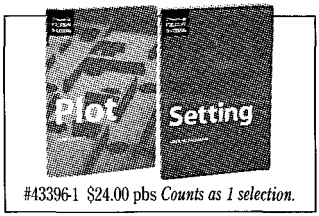

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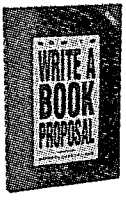

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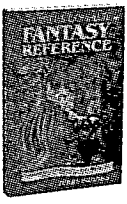

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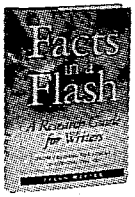

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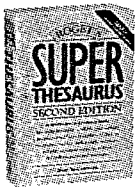

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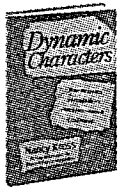

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SCIENCE FICTION AND FACT

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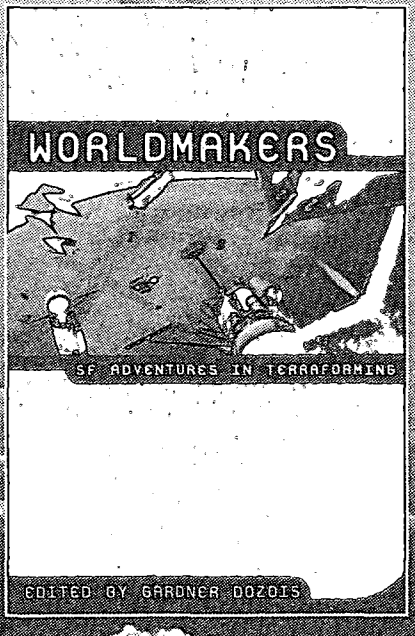

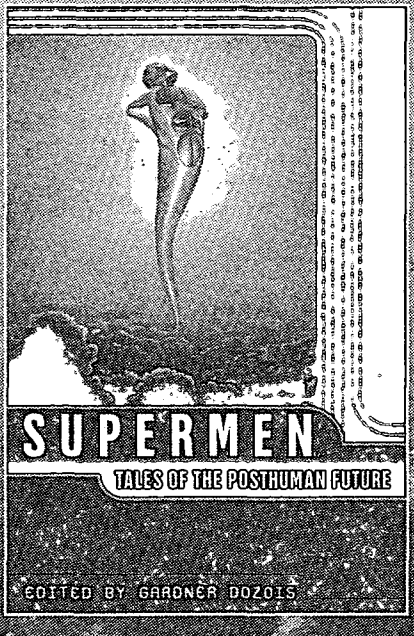

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MUSINGS FROM THE BIOETHICAL FRONTIER

As anybody who's been paying the slightest attention knows, biological researchers are now working on one of the richest frontiers ever encountered. Like most frontiers, this one offers, as President Bush put it when announcing a compromise on federal funding of stem cell research in August 2001, "both great promise and great peril." His decision to "proceed with great care" was commendable, as far as it went, but it was only a beginning. Some have condemned the president's decision to support *any* embryonic stem cell research as a breach of a campaign promise, but there is little virtue in keeping a flawed promise. Mr. Bush deserves credit for his ability to learn and willingness to recognize that the issues are more complicated than he originally thought.

Complicated they certainly are, and stem cell research is only one aspect of them. The two most prominently in the news as I write this are stem cell research and human cloning, which have a prominent zone of intersection. There is at least one other, not commonly mentioned in connection with those but no less important and just as inseparable. I'll come back to that later, but for now I just want to raise some questions that will need to be borne in mind as decisions are made about all these areas. I do *not* propose to offer final answers. Unlike many near both ends of these philosophical spectra, I don't claim to have any. But I do recognize that there are important ethical questions to be answered, and that finding good answers to them will depend on certain points that cannot be safely ignored but too often are.

Thus I call this essay "musings." It will consist largely of an assortment of thoughts that have occurred to me as I read media coverage of our leaders' initial gropings toward answers to these questions about stem cells, cloning—and that other thing too seldom thought of in connection with them. And I will point out arguments made by one side or another that simply don't hold water.

I assume I need not review, for *Analog* readers, the basics of what cloning and stem cells are, what might be done with them, and why some people are excited and others profoundly disturbed by those prospects. I will mention in passing, though, that similar debates and sometimes hysteria have surrounded every earlier introduction of new reproductive technologies—such as in vitro fertilization, which is now so routine that hardly anyone still thinks of it as shocking or immoral.

That reminder might lend a bit of perspective to discussions of the morality of taking stem cells from various sources. The Clinton administration was willing to support research on cells taken from leftover embryos stored by in vitro fertilization clinics, which collect several and discard the others after one has produced the desired result. Thus the embryos in question were not under any circumstances going to become full-fledged human beings. They were al-

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ready scheduled for destruction, so the only difference between using them for research and not using them is that using them might lead to useful new knowledge such as cures for currently hopeless diseases.

There are, of course, those who regard destruction of *any* embryo as completely equivalent to murdering a child or adult. Life, they say, begins at conception, and they make no distinction among different stages thereafter. I don't think anybody denies that *life* begins that early, but I cannot avoid recognizing a distinction among stages. The real question is whether *humanity* exists in full enough measure for the same moral considerations to apply at all stages.

Personally, I find the view that it does logically insupportable. A two-cell or two-hundred-cell embryo is not in any biological sense equivalent to an adult or even a child. "Potential human being" really is a reasonable and fair description of such an object, at least from a biological point of view. As one reader of my local paper put it, "Newly fertilized zygotes are one-celled organisms that are about as close to being babies as acorns are to being oak trees." Or, to offer another analogy, a very early embryo is a human being in about the same way, and to the same extent, as a set of blueprints and a few ounces of metal are a car.

Some religions deny such arguments by defining humanity in terms of a *soul* that they say springs into being at conception and is already as complete as it will ever be. I have no quarrel with anyone who wants to base his or her own actions on that belief, but anyone who wants *others* to act on that basis must reasonably be expected to convince them, and for many that will require *proof*.

In any case, the August Bush compromise was considerably more restrictive than the Clinton version. It would not permit the destruction of any new embryos to obtain stem cells, but would allow research only on self-sustaining lines of cells derived from those already harvested in the past. There appear to be a few dozen of these in existence, which can certainly provide a significant start on human stem cell research. But it's highly doubtful that those few represent enough of existing human diversity to bring the potential benefits of such research to everybody who could benefit from them.

And while the restriction, apparently aimed at partially appeasing those who see any destruction of embryos as murder, sounds high-minded in that it does not directly sanction any new destruction of life, that appeal is far more emotional than rational. It will not actually *prevent* any new destruction of embryos, but merely ensure that when it happens (and it *will*, as a routine part of the work of fertility clinics) it will not make any contribution to research. The choice, in other words, is continuing destruction of embryos *without* resulting

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research benefits, over the same destruction *with* research benefits—which might save many lives in the future. Put that way, does it sound quite so noble? Or might some other course be better, and warrant another shift in direction later?

And then we come to another possible source of stem cells: embryos cloned specifically for that purpose. This is, of course, the aforementioned intersection between the controversial areas of stem cell research and cloning. So far just about everybody in a position to make policy has steered far clear of this one, because so far the prevalent popular reaction to the very suggestion of human cloning is a powerful knee-jerk aversion. But it's not a universal reaction, and while I'm not in the business of making predictions, I will predict with considerable confidence that since human cloning pretty clearly *can* be done, it *will* be done. The relevant questions do not include *whether*; they do include *when, why, how*, and *under what restrictions*. Already there are scientists who consider themselves nearly ready to clone humans, and who plan to try; and individuals very interested in cloning themselves when the technology is available.

Naturally such a topic has produced lots of comments, many of which I also predict will look very different to many people in just a few years. I don't think I need to spend much time on the U.S. representative who, in supporting a categorical ban on cloning of human embryos, said, "This House should not be giving the green light to mad scientists to tinker with the gift of life." This is "straw man" argument at its best. Its perpetrator should be sentenced to getting to know some of the many very *sane* scientists who are interested in this work—and while we're at it, probably any medications he's using should be withheld on the grounds that they're all products of "tinkering with the gift of life."

On slightly more rational ground we have a number of individuals and committees who do have some familiarity with the field, but still make what I think history will view as errors of judgment and perspective. Some advise against allowing any form of human cloning because it's unsafe. "At present," one said, "there is no way to predict whether a given clone will develop into a normal or abnormal individual." I

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can't argue with that. It's true that there's a lot that isn't known about this field, and many of the early attempts will fail, some of them probably in pretty dreadful ways. But the same was true of any other medical technology you can name, from anesthesia to brain surgery to artificial hearts. The lack of safety and reliability is not an intrinsic evil of cloning *per se*. It's a perfectly predictable consequence of the fact that we're *beginners* at this and have a lot to learn. And learn we will, given the chance.

One research director has an answer to that: "Practice makes perfect. But is it ethical to practice on humans? I think it isn't." The fact is that we can *only* practice on humans, once we reach a certain point; and this, too, has been just as true of every previous medical technology as it is of this one. Computer models and laboratory animals can only go so far in learning how to work with humans. None of them is exactly equivalent to a human; and if you ever want to learn to do good, safe, reliable brain surgery or heart surgery (or cloning) on humans, sooner or later you have to try it on humans. You *will* make mistakes and lose some patients. But you will learn from those mistakes, make fewer, and eventually have something that saves far more lives than the learning cost. A frontier technology can *never* be held to the same standards of safety and reliability as a mature one. If you try to insist on that, you will never get the safe, reliable, mature one.

An argument against cloning that seems to me harder to dismiss is that it eliminates the evolutionary advantages of sexual reproduction. One of the scientists who were planning to attempt human cloning when I wrote this (and may have done so by the time you read it) was quoted as saying, "I do believe that it's a fundamental right to reproduce the way you want. If you want to reproduce by mixing your genes with someone else's, you have the right. If you want to reproduce yourself by cloning your genes, you have the right." But do you? I remind you: I'm not *answering* the question, but I insist that we have to ask it—and think seriously about the answer.

And we have to ask a bunch of related ones, too. If you do have the right to clone yourself, to what extent should that be allowed, and under what restrictions? What if everybody decided to relegate sex to recreation and use only cloning for reproduction—a prospect undoubtedly repulsive to many but with certain undeniable appeals for others? Facts to ponder before answering: Sexual reproduction is an assured (formerly enforced) chance to try a *new* genetic combination. (Shudder! Gasp! You mean every child is a human experiment? Well, yes. . . .) Cloning is a guaranteed repetition of something that's already been tried. Is that preferable to something (somebody) new and unique? Is it a good idea to have different people using *both* approaches? Is it equally desirable to repeat *all* human designs? How many Albert Schweitzers or Albert Einsteins do we need? How many Charles Mansons or Adolf Hitlers? How many Ralph Kramdens? Who decides?

Finally, there is that third big issue I hinted at a while back. There appears to be little doubt that stem cell research, some of which might involve cells produced by cloning, can lead to major medical breakthroughs that might in turn cause major increases in life expectancy. But is *that* always or necessarily a good thing? That question cannot be answered meaningfully unless you look at it in conjunction with another: what effect will it have on population, and all the things that depend on that? Increasing life expectancy, without a corresponding decrease in birth rate, inevitably leads to a speed-up of population growth. That in turn leads to an increase in resource use, atmospheric and water pollution, and a host of other unpleasantries.

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We already have a number of resources, such as fisheries and forests, which, on a worldwide scale, are being consumed far faster than they're being replenished. If civilization as a whole does everything it can to make life expectancy as high as possible, it had better be concurrently working on ways to reduce the adverse effects of high population growth and per capita consumption. That's not an easy task, because it directly pits individual-scale morality against species-scale morality. Certainly if you or someone you love is losing a battle with leukemia or Alzheimer's disease, you'd like to see a cure developed as soon as possible. But what's good for you or me or Grandpa is not necessarily good for humanity as a whole, if it's repeated millions of times over. That simple logical fact will force us to confront some very hard questions, but we cannot afford to ignore them and hope they'll go away.

Once upon a time some well-meaning humans introduced European rabbits into Australia, without its occurring to them that rabbits had no natural predators there. The result has been boom-and-bust cycles in which rabbits, in green years and with no predators to control their numbers, multiplied to the point where they ate all the available food—whereupon, of course, almost all of them died.

It wasn't the rabbits' fault. They didn't understand ecology, or voluntary population control. Most humans don't, either—but they can and must learn. ■

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Hearts in Darkness

H.G. Stratmann

So we'll go no more a-roving
So late into the night,
Though the heart be still as loving,
And the moon be still as bright.
—G. N. Gordon

"Valentina is wearing make-up."

Stone stoically watched the needle jab his arm, sending dusky blood spurting into a red-stoppered glass tube. The cardiologist locked his feet against a low horizontal rod welded to the U.S. Laboratory Module's side, then coldly shrugged. "So?"

Morita slid the needle from Stone's vein and pressed an alcohol pad against it, grabbing his crewmate's arm to keep from floating away. The biologist smirked, "You should see her. All dolled up and dressed like a Victoria's Secret model. A wet dream come true."

Stone frowned. "Boris might not appreciate you talking about her like that."

"I think he likes it when somebody ogles Vali. Isn't that what a trophy wife's for? To show off what you get to screw?"

"I wouldn't know."

"Too bad." Morita poked the needle into a sugar cube-sized Styrofoam block. He pushed off from the "floor" and darted toward the sample centrifuge-analyzer rack at the other end of the cylindrical module, shaggy black hair trailing behind him like a Shuttle's exhaust trail.

Keeping his feet secure, Stone briefly applied pressure to the venipuncture site, discarded the crimson alcohol pad properly into a plastic waste bag, then rolled down his gray jumpsuit's sleeve. Stretching his lean, nearly two-meter tall frame toward a nearby laptop, he tried studying graphs comparing his five crewmates' muscle mass and bone densiometry measurements to his own during these last four months on the station. But he kept wondering who Vali was getting "dolled up" for.

She shouldn't even *be* here. It was unusual for someone's first trip into space to be a six-month tour on the International Space Station. It was unheard of for anyone to join a crew they'd never trained with on Earth—and for good reason.

Maybe it was just another symptom of how sick the Russians' space program was. For over twenty years they'd extorted most of the cash to build their modules and keep Progress supply ships coming to the station from NASA and the other partners. Now the Russian Space Agency even threatened to withdraw from the ISS and SPLISH-SPLASH if they didn't get more bribe money. They didn't realize nobody *needed* them anymore—

"I'm downloading your results."

Morita floated over, his sallow ferret-like face peering over Stone's shoulder

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at the data scrolling onto the laptop's screen. "Looks like you're a successful lab rat. Wish my serum calcium and phosphorus were as good as yours. At least *you* won't topple over and break a leg when we go home."

Stone ignored him, fingering one of the paired form-fitting devices hooked behind his ears. The icy steel-gray metal vibrated as its microgyros sent pulses through his mastoid bone to his vestibular nerve. To medical researchers in Houston, he was merely "Subject No. 6" in their Dedicated Universal Countermeasures to Microgravity experiment—designed to keep his body anatomically and physiologically similar to its "normal" state in 1 *g*.

Those "vestibular stabilizers" he wore supplemented signals from his inner ears' semicircular canals and otholith system so, whenever he turned his head or moved, his brain received the same body orientation and position information it was used to getting on Earth. Thin, lightweight, microprocessor-controlled negative-pressure "trousers" over his jumpsuit kept body fluids from shifting from his lower to upper body—preventing the facial puffiness and nasal congestion that plagued his unenhanced colleagues. His "special" diet included potassium citrate, antioxidants, and equally delicious nutritional supplements.

And there were those delightful injectable medicines. Erythropoietin, to keep red blood cell mass from falling. The latest cysteamine derivative and other radioprotectants, to reduce cell damage from higher levels of radiation than any terrestrial worker faced. New genetically engineered osteoblast stimulating factors and "myocyte stabilizers," to keep gravity-deprived lower extremity bones from demineralizing and weakening, and muscles from atrophying.

On Earth, he hated to take aspirin. In space, he was the poster boy for polypharmacy.

Morita squinted at the musculoskeletal data graphs. "Hell, your numbers aren't any different from when we launched! Hmm . . . I still have the second-best readings. But poor Boris! At the rate he's losing bone and muscle mass, he'll wind up a 99-pound weakling. Must be doing . . . *other* things besides exercising."

"He spends as much time on the bicycle and treadmill as you."

"Yeah, but he's nearly twice as old as me. Maybe he needs to exercise twice as long too. At his age, it must take a lot longer and more effort to do everything."

Morita tensed his bare biceps in a Charles Atlas pose. "Do you think Vali prefers men with big muscles?"

Stone's glare seemed to physically push the biologist away. Morita blinked and disappeared through the far hatch. "If you don't need me, I'm going to TransHab for a snack."

"I don't need you."

Now truly alone in the dimly lit Destiny lab module, Stone didn't try concentrating on his regular duties. Maybe he was worrying about Boris and Vali for nothing. Maybe his suspicions were paranoid fantasies generated by a mind isolated too long.

Or maybe they *were* real, and the station was an orbiting time bomb. He might be the only person on board who realized how dangerous the problem was—or even recognized it as a problem.

The problem of sex in space.

Stone grit his teeth. No choice but to discuss it with LeBeau. As commander, he was ultimately responsible for everyone on the station.

The physician disengaged his feet from the restraining bar, and cautiously pulled himself several meters into the adjoining Unity node. But despite moving carefully, the empty module spun nauseatingly around him.

He quickly locked his feet through another bar, and waited for his surround-

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ings and stomach to settle down. *Stupid VSs!* His crewmates' neurovestibular systems adapted long ago to microgravity. They could somersault, float, or swim like dolphins with impunity.

But if *he* tried any acrobatics, his unadapted brain suddenly thought it was whirling on a manic merry-go-round. Right now, it didn't help that—theoretically—he wouldn't have the problems standing and walking they'd have readjusting to Earth's gravity after landing. Still—if his misery showed the VSs could help prevent the first person setting foot on Mars from unheroically falling on his or her face on worldwide TV after months of "weightlessness," it was worth it.

The small observation window beside him showed the station was moving back into Earth's shadow. As he watched the tediously familiar scene, a last glint of sunlight disappeared behind the planet's edge—plunging it back into night. Like the opening of *2001* in reverse, though several days shy of twenty years too late. His mind played a fragment of Strauss's *Also Sprach Zarathustra*—its rumbling chords and rising trumpet exultantly proclaiming the birth of the *Übermensch*, and the death of God.

Stone's haggard face reflected faintly in the window. His stubbly beard was more salt than pepper, and his utilitarian Mercury Seven-style crewcut accentuated the gray metastasizing through his thinning brown hair. Reminders he was in his mid-forties—and the best years of his life were past.

He sighed. What do you do *after* your dreams come true? Was getting into space worth all those years of work—or sacrificing all his other needs and those of the people he loved? Right now, instead of drifting like a lonely island in the uncaring void, dealing with diseased attitudes and behaviors that were probably incurable, he could be doing something easier. Like standing in a busy ICU saving the life of somebody with an acute MI.

Stone shook himself. *Remember those lectures you give astronaut trainees about how common depression and feelings of isolation are toward the end of a half-year tour on the station? Physician, heal thyself!*

Still nauseated, he pulled himself into the jug-shaped TransHab module's central tunnel. "Down" past the deserted Crew Health Care Area, its treadmill and stationary bicycle standing unused. Down through its middle section, with the equally empty seven small compartments of the crew quarters.

As he descended into the galley at the module's far end, Stone heard two men snickering.

"—should hang a sign on the hatch to Zvezda. 'When the module's rocking, don't come knocking.'"

"The last time they sealed it off, you could hear her moaning all the way to Unity! Maybe she should change her name to 'Polly Orgasmic'."

"The way she's made up, she must really be hot. If Boris can't get it up, one of us young studs might get lucky—"

As Stone emerged into the dark galley it went silent. Morita and Newkirk floated near the expansive table that dominated the module, each clutching a long protein bar. They grinned sheepishly at him—like two junior high students caught thumbing through a contraband girlie magazine by the school principal.

Stone glared, "Where's LeBeau?"

Morita wadded his food wrapper into a ball and let it float beside him like a tide-locked satellite. "Beats me. Why don't you raise him on the intercom?"

"I need to talk to him—in private."

Newkirk raised bushy raccoonlike eyebrows. "About what?"

"I said, it's private!"

Morita yawned. "He's probably in the ESA lab."

Stone snatched Morita's discarded food wrapper and placed it in a disposal unit. The other two men silently floated away to the opposite side of the galley, the cylindrical module's central tunnel

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separating them from his sight. He heard them whispering and snickering. His ears picked out the word "stone" from their otherwise unintelligible babble. Then Newkirk starting humming an old Simon and Garfunkel tune off-key—"I Am A Rock." More laughter.

Stone peered out an observation window at the night-shrouded Earth. *Won't it ever be day again?* He gazed longingly at one of the station's two Crew Return Vehicles, shaped liked a miniature version of the Shuttle with its wings' tips bent up, docked tantalizingly close by. A set of solar arrays, functionally useless now in Earth's shadow, seemed to waft and cool the small white vehicle like a huge fan. He wished he were in it—preparing to go home and escape from his worries.

Disgusted and sick, Stone climbed back to the Unity node. He dragged himself once again through the Destiny lab module, opened the hatch to its connecting node, and crawled into the ESA's Columbus Laboratory module.

LeBeau looked up from a crystallography experiment—his face first flashing a leer, then disappointment. "Oh, it's you."

"Do you have a minute?"

"No—well, what do you want?"

Stone moistened his lips. "I'm worried about Vali."

"Why? Is she ill?"

"No, she's very healthy. I'm worried about the effect she's having on the rest of the crew's morale—and maybe, their safety."

The muscular Frenchman tossed back a leonine mane of blond hair, and squinted suspiciously. "Explain."

"She shouldn't *be* here. It's standard procedure for crews to train with each other for months before going into space. That way everyone learns to work as a team to complete mission objectives—and, just as important, they see how well they get along together. If there are any serious personality clashes among the crew—if they find they hate each other's guts—better to find out *before* they leave Earth so interpersonal conflicts can be resolved or crew rosters changed, than *after* they get up here!"

"I've seen no problems. Except for Vali, the rest of us have known each other for years. We've all been on Shuttle missions with each other before being selected for the station."

Stone frowned. "Yes, *five* of us have worked together long enough to smooth out any psychological 'rough edges' we might've had at first. Same with Golda Verchinski, who was *supposed* to come up with you and Boris last month—instead of a freshly-trained novice."

"Are you saying Vali isn't qualified to be here?"

"From what I've seen of her work, she seems reasonably competent. Medically, including all the times I've checked her, she's in excellent health. But that doesn't explain why she was 'promoted' over considerably more experienced cosmonauts we've already worked with."

LeBeau snickered. "It's elementary, my dear *doctor*. Vali slept her way to the top."

Stone suddenly felt dizzy—then realized his feet had worked free of the restraining bar he'd reflexively secured himself with upon entering the lab module. He grabbed one of the experiment racks lining the module and rooted himself back to its side, resisting an urge to vomit. A pink-eyed albino mouse examined him curiously from its enclosed plastic cage inside the rack—wondering what all the fuss was about.

Pale and sweating, Stone muttered, "You're kidding. Not even the Russians would sink that low!"

The commander grinned. "She bed-hopped through dozens of low-level bureaucrats in their space agency. When they finished with her, they introduced her to their bosses. Then those middle managers opened doors for her to meet

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their superiors—until she got 'access' to the cosmonauts themselves.

"I'm surprised Boris married her. Why buy the cow when you're getting the milk for free? What Vali got was her doting husband pulling strings for permission to bring her along with him."

LeBeau smirked. "And Boris still gets his milk. Have you noticed Vali showers in TransHab every other day, instead of weekly like the rest of us? She's very adept at slathering soap and water over her entire body, then suctioning them from her bare skin. Then she puts on a negligee and makeup for a rendezvous with Boris in one of the Russian modules."

"So I've heard."

"I hope you're not *shocked*, doctor. I've noticed *some* Americans seem puritanical about such matters. At least officially, or when they don't have the opportunity—or courage—to freely express themselves sexually. We Europeans tend to be more sophisticated, more adult in these areas."

Stone hardened. "I've been a physician for twenty years. *Nothing* dealing with human biology—including sexual activity—shocks or offends me any more. I'm *not* interested in making moral judgments about what other people do—or acting as censor over their personal lives. If we were on Earth, this wouldn't be an issue except to Boris and Vali.

"But we're *not* on Earth. All six of us are locked up on this station. We can't get away from each other—or our problems. Still, I am bothered when people do stupid things. And when those stupid things might endanger the health and safety of the crew, I *have* to make it my business!"

The commander chuckled. "Are you saying it's *unhealthy* for Boris and Vali to make love?"

"No. Based on their medical records and the exams I've given them, there's no obvious health risk to it. I'm a bit concerned Boris's exercise tolerance has dropped lower than expected recently. But he's still better conditioned than most terrestrial sixty-two-year-old men—and should be up to the relatively mild physical demands of having sex.

"And Vali's very fit—as you'd expect in someone twenty-nine years old with excellent preflight health. The chance of her becoming pregnant—which *would* be a major health hazard in space, both for her and the embryo—is infinitesimal. Boris had a vasectomy when he was forty. Interestingly, *she* had a tubal ligation three years ago. She's nulliparous, and didn't have any medical reason for it—except, from what you've told me, the obvious one."

Stone frowned. "It's not like they're the first people who've done it in space. NASA's kept a 'Don't ask, don't tell' wrap on this for years. The last thing they needed was another proposal to slash their budget from hypocritical demagogues in Congress demanding to know why billions were being spent on 'hanky-panky in the high frontier.'

"But there are anecdotal reports in the files. Problem is, even if those experiences felt good for the participants, scientifically they're worthless. No way to control for their natural tendency to exaggerate the successes—and downplay the failures. With more men and women staying off Earth for longer times, we need to conduct formal studies of how effective and safe sex is in space, just as we've done for every other aspect of human biology. Until then, the unofficial policy is still 'Be careful, be discreet'—and don't get too distracted and injure yourself or a partner by floating into an instrument rack and hitting your head."

LeBeau snorted. "When they approve those studies, sign me up! But if Boris and Vali are careful, why do you say it's a problem?"

"It's not just them I'm worried about. *Because* Morita and Newkirk haven't trained or worked with Vali before, they might see her more as a potential sexual

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partner than a colleague. It's impossible to maintain conventional levels of modesty on the station, and they've had plenty of opportunities to see she's very . . . attractive. Plus, they're both in their early thirties, heterosexual—and have been forced to remain celibate for over four months. You don't need a medical degree to see they might be pretty horny by now!"

"How serious you make it sound! Those stirrings are perfectly natural. As long as they don't *rape* her, it's none of my business—or yours!—even if she decides to 'relieve' them."

Stone glared at him frigidly. "That's *exactly* what I'm afraid of. *You* know about that incident here two years ago. *That* crew didn't have any 'problems' either, until Stevens caught his wife practicing zero-gee sexual gymnastics with their commander. He was lucky Stevens only managed to slash his thighs with a knife before the others stopped him. Just think what a PR nightmare it would've been if he'd cut off the parts of Lecoque's body he was aiming for—and forced an emergency evacuation to Earth for medical treatment! I don't want Boris going on a rampage against Morita or Newkirk as the cuckolded husband—or, even if he just *thinks* one of them is getting it on with his wife, re-enacting the starring role in *Othello!*"

The commander smiled smugly. "Perhaps you're citing the wrong play. Boris might be like the husband in *Mandragola*. But I don't suppose you know what I'm talking about."

Stone stiffened. "Just because I'm a physician doesn't mean I read only medical literature. I'm familiar with Machiavelli—especially his nonfiction. My opinion of human nature is as realistic as his."

"Oh? I noticed you didn't mention *you've* been on the station as long as Morita and Newkirk—and are just as sexually 'deprived.' With all those physicals you give us, you see Vali naked more often than Boris! A psychiatrist might think you're projecting your own repressed lusts for her onto them. Or perhaps you're an Alceste—a self-righteous hater of humanity and their weaknesses. Though I doubt you're well-read enough to understand *that* allusion!"

Stone stared frostily at LeBeau. "Let's not get personal. You're the commander, and I've reported a potential crew problem to you. It's your responsibility to do something about it."

"To me, there *is* no problem. If you still think so, talk to Boris yourself before you confront anyone else—especially Vali. That's all I have to say on the matter—*doctor*."

"If *you* won't, I'll speak to Boris. And believe me, for everyone's sake I hope I'm wrong about this!"

As Stone crawled "up" the lab's side like a poisoned ant, he sneered back over his shoulder, "By the way, I've read Molière—and I'm *not* a misanthrope!"

Disgusted with himself, Stone pulled himself toward the Russian end of the station. *LeBeau acts like a pompous pseudointellectual jerk—and do you keep your cool and act professionally? No, you act like a bigger jerk!*

No point waiting to talk with Boris. *Somebody* had to take responsibility. *Just wish it wasn't me.*

As he passed back through the Unity module, Stone peered again through the observation window. Some 400 kilometers below, Europe and northern Africa lay cloudless in sable night. He gazed wistfully at Cairo—wondering if Naseer had made it home to his family.

Strange how one's perception of people can change. When they'd started training together eighteen months ago, the station's pudgy previous commander seemed stern and unsociable. But, while working together here over the last three months of the Egyptian's tour, they'd discovered a surprising number of common interests. Like a passion for classical literature and music.

Rose and Edith, the other veterans of

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the prior crew, provided more than intellectual companionship. The two grandmothers—charter and sole members of the Shannon Lucid Fan Club—had taken the three "youngsters" under their wings when the Shuttle brought them up four months ago. They'd nursed Morita and Newkirk, suffering from bad cases of Space Adaptation Syndrome, during the pair's first miserable days on the station. Fellow physician Edith—a pulmonologist, and DUCM "Subject No. 5"—was a special mentor to him, using *her* experiences to help him cope with his tribulations as the project's latest guinea pig.

He'd rarely felt lonely those first three months on the station. The exhilaration of finally living here and a time-absorbing work schedule kept his mind healthily occupied. And whenever he felt himself missing his wife and kids, he could commiserate with Naseer, Rose, or Edith. They'd been married even longer than he had, with many children (and grandchildren) of their own to miss.

When the Shuttle came to take his three friends home a month ago, the four of them had a private party in the brightly-decorated Destiny module. Ignoring his vertigo, he'd danced a whirling microgravity tarantella with Rose and Edith while Naseer incongruously piped the Preludio from Bach's Partita No. 3 in E Major, BWV 1006, on his soprano recorder. Rose invited him to her granddaughter's Maryellen's confirmation in five months—followed by a family feast showcasing her special homemade lasagna, a recipe handed down through generations of Sicilian ancestors. Not to be outdone, Edith extracted his promise to attend her oldest grandson's bar mitzvah. "And," she said, "if your VSs keep making you sick, take this medicine." He'd laughed at the label on the tube of food paste she'd handed him.

Chicken soup.

Cloistered in the gloomy module, Stone heard muffled voices drift up from the depths of TransHab. Two simpering male ones—and a single tittering female. Grimly hoping Boris wasn't "down" there, he opened the hatch to the Zarya module.

The first of the station's components to reach orbit was now little used—and grossly misnamed. Only tiny warning lights illuminated its musty interior. Stuttering air circulation fans uselessly cooled the racks along its walls holding, like tombstones, dead electronic equipment from long defunct experiments.

Then, through another hatch, into the equally dark, empty Zvezda module. Scattered display panels glowed dimly with faint signs of electrical life. The amount of scientific work the Russians still supported here and in their research modules was pathetic. As much as he and the others grumbled about how *their* work had been scaled back to fund SPLISH-SPLASH, this was far worse.

Preparing to penetrate deeper into this technological graveyard, Stone grimly wished Virgil was here to guide him. As he headed back toward the opening leading to the two Russian research modules, he heard a sharp clank and several rumbling curses in Russian behind the closed entrance to the CRV attached to the far end of Zvezda.

What's he doing in there? Stone rapped politely on the metal hatch.

It flung open. Boris boomed, "Some company! Come in, my friend!"

Grabbing the physician's arm, Boris yanked him into the nine-meter-long CRV. Dizzy again, Stone tried focusing his eyes on the tangled rainbow-colored wires floating like a hydra's tentacles from the craft's large instrument console.

Boris grinned. "Don't mind the mess. The communication system failed when Newkirk tested it last shift. He asked me to fix it."

He pointed to a chunk of electronic components rotating uncomfortably close to Stone's head. It reminded him

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of the install-it-yourself car stereo system he'd tried—unsuccessfully—to put in his old '13 Ford minivan.

"Uh—Boris, I thought only Newkirk and LeBeau were certified to repair the CRVs."

The Russian twisted two bare wires together—then cursed as a jolt of electricity lanced his fingertips. "They are. But, with little else to do, I've reviewed the repair manuals, and had them teach me everything they know. When I was on Mir long ago, it was a slow shift if we didn't have several repairs like this. Another few hours work, and this craft will be better than new."

He slapped Stone on the back—rocking the doctor back and forth from where he'd secured his feet like his son's old Bernie the Dinosaur punching bag toy. "Don't worry, my friend. If we must leave the station before then, there's still the other vehicle. And as long as the automatic navigation system is working, who needs to communicate with Earth during a descent? Besides, there's never been an emergency evacuation."

First time for everything. Stone shivered, remembering when his main parachute didn't deploy properly during a training jump last year. As reliable as these pale wide-bodied successors to the venerable X-38 were supposed to be, the idea of trusting his life to a parafoil wasn't appetizing. *They* didn't have a dependable reserve chute to prevent you from splattering into fertilizer when you hit the ground instead of limping away with only bruises.

As Boris wound gobs of electrical tape around a power cable, Stone hesitated. Doctors shouldn't be at a loss for words with patients. But this problem needed a *friend's* help—and he doubted Boris *really* considered him "my friend."

Stone rasped, "I need to talk to you about something."

"Please talk."

"It's about your wife."

Boris convulsed as if a cattle prod had shocked his privates. "Is she hurt?"

"No, it's about . . . are there any problems between you and Vali? Anything I can help with?"

The Russian's face sagged into a melancholy smile. "No. Nothing you—or I—can do."

He sighed. "Do you think Vali is—attractive? Sexy?"

Stone stammered, "She's very . . . nice. A fine scientist, and great asset to the station. You're lucky to be married to her."

And, a nasty voice whispered, *her teeth are really straight too. Great interview skills, doctor!*

Boris nodded. "She *is* attractive. Too attractive for *me*."

Stone winced as the Russian's eyes burned into him. "Look at me, my friend. Once I was young and handsome. The best MIG pilot in Afghanistan. A Hero of the USSR. The prettiest women in the Motherland had to 'take a number' for my favors. Even in the dark years after those fiends Gorbachev and Yeltsin betrayed our country, my good looks still brought me as many women as I could undress. The night I returned from my first tour on Mir, before rising from my bed I serviced *three* so young they were almost virgins. But later, for too many years women only 'respected' me as a space hero—and I almost always slept alone."

The Russian's lined face seemed to cave in. "Look at me—and see why. I'm over sixty. My jowls sag, my eyes are baggy. See my wrinkled forehead—the whiskers that make me look like Father Frost! Despite all the exercise I do, my strength is failing. The only reason I'm here is because young, virile cosmonauts have no use for this old 'trash can.' No, *they* are the lions in their prime—clawing their way to be selected to build the first permanent base on Luna, your 'South Polar Lunar Ice Sustained Habitation.' *They* will extract water from regolith to create more liquid oxygen and hydrogen fuel for their rocket. *They* will pilot your foolishly-

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named 'Staged Prototype Luna-to-Ares Shuttle and Habitation' on to Mars.

"Let the old men—the used-up men—have *this* orbiting relic for their home, and grave!"

Boris grinned like a death's-head. "Lucky to be married to Vali? Lucky to have someone less than half my age—so beautiful, so passionate—for a wife? Lucky, yes. But cursed too."

He laid a bearlike hand on the physician's shoulder. "Thank you, my friend. There's nothing you can tell me I don't already know. Whatever Vali does with other men, I will endure—and enjoy whatever happiness she chooses to give *me*."

"Isn't there anything I can do to help?"

"No. Except . . . perhaps as a doctor."

Boris pointed to the center of his chest. "I had pain here the last time I exercised on the treadmill. Maybe you can give me a pill for it?"

"What kind of pain?"

"Just a pain. A pulled muscle."

Finally dealing with something he *was* comfortable with, Stone answered, "It might be something else. Is it a sharp pain? Dull? Pressure?"

"Yes, it's a—never mind. It's not that bad."

"Boris, I need to know. It's probably nothing serious, but you better come back with me to the Health Care Area so I can check you over."

"Later, my friend. After I finish my work here, I'll let you do doctor things to me."

After more fruitless cajoling of his suddenly taciturn crewmate, Stone gave up. Trying to get Boris to cooperate when he didn't want to was as futile as making the bankrupt, ever-shrinking Russian Federation into a world power again.

"If you need anything, call me on the intercom."

Boris nodded.

Retracing his path, Stone paused in the Unity module to let his stomach catch up with the rest of him. Below, deep in TransHab, a third male voice—bubbling in lascivious French—elicited tinkling feminine laughter.

Why am I not surprised.

Disgusted in spite of himself, the doctor crawled back to the gloomy Destiny lab module, closed its hatch, and opened the small locker protecting his tiny stash of books, music chips, and other personal effects. Ignoring his pocket edition of Byron's poetry and miniature copies of Cicero's *On Moral Duties* and Seneca's *Apocolocyntosis*, Stone removed a player and attached it to his waist. Careful not to disturb his VSs, he placed a flimsy headset over his ears and shuffled through his meager music collection.

Mahler's Seventh Symphony? Too bombastic. A Haydn "Sun" quartet? Not even the C Major could brighten his spirits.

Mozart. Nobody can stay depressed listening to Mozart. He hesitated over a chip containing several serenades—No. 6 in D Major, K. 239, and No. 13 in G Major, K. 525. No, his mood was dark enough already.

Die Zauberflöte wound up in the player. *At least it has a happy ending.*

But even the opera's sprightly overture couldn't dispel his disenchantment with his crewmates. If it didn't bother Boris whether one of the others seduced Vali—or vice versa—and there were no medical issues involved, it was none of his business what happened between consenting adults.

Still—the monumental *stupidity* of it all irritated him. A marriage of convenience like Boris and Vali had wasn't really a marriage at all—merely a business agreement between two independent contractors that included sex as one of the terms. There might be a modicum of mutual caring—but no real love, or desire to truly share their lives, pleasures, and pains together.

And what about the others? He'd met

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LeBeau's wife and their doll-like five-year-old twin daughters last year. At least Morita and Newkirk—each married about a year—didn't have any kids to be potential innocent victims of adultery and divorce. Did they think that if their "loved" ones didn't discover what happened, it *didn't* happen? That being here in space—cut off from the rest of humanity—made nothing they did here "real"?

Maybe that explained why those two felt no shame treating Vali like first prize in an emotionally-bankrupt sexual competition. Or maybe they shared LeBeau's "sophisticated" attitudes about sex. There was nothing sophisticated about using another person as just a *thing* to satisfy your own pleasure. It was the unbridled self-centeredness of the three-year-old—the blind unthinking hormonal insanity of adolescence—coupled with the power and ability to rationalize of an adult.

Loving another person meant caring about them for *their* sake, not just as a vehicle for your own selfish gratification. Love was *hard*.

But sex *without* that kind of love was easy. Anybody with the proper anatomy and hormones could do *that*. No thought, no brain required—except to figure out how to get the belusted into bed. Using one's reasoning powers, not as arbiter of the passions, but their slave.

Humean, all-too-Humean.

No, he felt sorry for people whose desires stopped at such a shallow, superficial level. They wouldn't understand that sex with someone you truly loved—someone you'd committed your life to unreservedly—was far more pleasurable than sex with just another person's *body*, no matter how physically attractive.

Explaining the difference would be like describing Bach's Mass in B Minor to someone deaf from birth. Some things you could only understand by having felt and experienced them. Even trying to explain what real love was would probably shut their minds tighter against the idea. It'd sound like he was preaching at them. And nobody likes to be preached at—even if the sermon's a good one.

As "Der Vogelfänger bin ich ja" warbled in his ears, Stone extracted a well-worn photograph from his locker. An accommodating passerby had snapped the four of them with the White House as background during their family vacation last spring. Donna's gleaming smile beamed back at him from the glorious sunshine of that long-ago day. His wife's arm was wrapped warm and close around his waist—always supporting him with her love.

Mary, their thirteen-year-old, looked glowingly back at him with her own special affection. She was blossoming into a lovely young woman, with honey-brown hair like her mother's. Soon he'd be supplanted as the most important man in her life. Before leaving Earth, he'd lost count of the times "Johnny"—the boy she called her "angel"—had telephoned his daughter. Without meaning to, he'd metamorphosed into the comically overprotective father of ancient sitcoms.

Eleven-year-old Jeff's eyes were bright with mischief. Sometimes the boy was exasperating—especially on school nights when homework that should've taken thirty minutes stretched to four hours of constant cajoling. But it was still nice being a parent. Was it only eight months ago he'd been proudly introduced to a classroom of awestruck fifth-graders as "My Dad, the Astronaut"?

Tenderly holding his family in his hands, Stone cursed himself. *He* was guilty of worse infidelity than the extramarital quickies the others might be contemplating. *He'd* betrayed his wife by selfishly pursuing the one dream they didn't share.

It wasn't supposed to be this way. Before they'd married right after graduating from medical school together, he

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and Donna agreed how they'd start their life. After she finished her pediatrics residency and he his cardiology fellowship together in Houston, they'd go into private practice and start their family. Everything went according to plan—until one of their visits to the nearby Johnson Space Center when, partly as a joke, he'd picked up and mailed in an application form for astronaut training.

He wasn't accepted—not yet—but they wrote back encouraging him to enroll in their newest program training physicians as specialists in space medicine. It meant more years of study, less money than private practice when he finished—and many arguments with Donna. But finally, after convincing her this was really what he wanted to do, she'd shown her love by sacrificing her own needs for his.

And so, as his wife's pediatric practice became busier and the kids were born, gradually he'd stepped closer to living his boyhood fantasy. While Donna often functioned as a single parent during his long hours at JSC and trips away from home, he'd acted as medical consultant for Shuttle missions, taught astronauts—and finally became one himself. Especially this year, preparing for this tour on the ISS, he'd only been moonlighting as a husband and father.

Even now a parasitic part of his psyche clung to the hope he'd be selected for SPLISH-SPLASH. Though he wouldn't be the first person to set foot on Mars, being the twentieth would be good enough. Except—it'd mean more precious, vanishing time away from those who needed him. Even if Donna agreed to that too, was it right for him to keep their marriage an afterthought in his life? Was living out his private dream worth the price?

Meanwhile, a bullet-sized meteoroid flashed out of the void unnoticed. It missed his lonely module by several meters before plunging toward the darkened world below, and ending its eons-old life as a transcendental streak of light across the starlit night sky.

Stone jerked as if he'd been struck—twisting away from the unexpected pressure on his left shoulder. He tore off his headphones, leaving them floating beside him as they played a tinny version of "Alles fühlt der Liebe Freuden."

"I didn't mean to startle you!"

She was a phantom of angelic delight, gently wafting before his bedazzled sight. Her supple legs were bound tightly in black fishnet stockings, their warmth palpable this near him. The frilled edge of a radiantly raven-hued diaphanous negligee fluttered just beneath her slim waist. Its silk and satin molded her upper body into a thrilling landscape of taut flesh, gentle curves, and rounded breasts constrained and accented by the fabric's sensuous embrace.

Valentina smiled at him invitingly with full vermilion lips, parted to reveal a hint of brilliant white teeth. Her cheeks were delicately dusted with rouge to bring out their natural vitality. Green-tinted eyes shone like scintillating twin suns, surrounded by a dark corona of finely-tapered eyelashes. A slow descent of blue-blushed eyelids sent them into brief eclipse, only to shine again in torrid glory. Cascading ebony hair was tamed and woven into a complex braid coiled behind her head.

Lithely floating in front of him, Vali caressed his damp forehead with the soft sure tips of a pianist's fingers. "I've been looking for you."

Stone vibrated in sympathy with her dulcet soprano tones. "I've been . . . thinking."

An autumnal sadness shaded her face. "You must be lonely here."

"I manage."

Her bright eyes pored deep into his, as if reading the diary of his soul. "It's wrong for you to be so alone. Deprived of warmth and light, like a monk in a dirty cell."

Vali gently squeezed his clammy hand.

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"Come with me, and let me heal you."

Stone gazed back at her—stunned to see his own loneliness reflected in her eyes. The exquisitely enticing perfume she wore flooded his senses, a springtime blend of lilacs and honeysuckle. His face prickled with the summer heat of her body gliding so close to his. Her mouth melted into a coaxing smile. With a sweep of his arms he could thrust her against him—sear his frozen wintery body against her fiery heart, and quench so many pains in an incandescent moment of passion.

But his feet stayed fixed in the module's metal rungs—resisting Vali's butterfly-delicate tug. Too much of him recoiled in bittersweet horror.

It's me *she wants!*

"No."

Instantly the spell shattered like crystal. Vali stared at him with innocent wonder. Then she noticed the picture clutched tightly like a talisman in his hands. She gazed wistfully at it. "Is that your family?"

"Yes."

"Your wife seems very—nice."

Stone glanced down at the frumpy, bespectacled middle-aged woman in the photograph. An overweight matron of average height, dressed unattractively in shorts and a plain white blouse, with dirt-colored brown hair beginning to streak with gray.

"She is."

"You're very lucky."

Floating free, Vali arched her back, flexed her knees and let her thighs fall to either side. "If you change your mind, I'll be waiting for you in TransHab."

Stone didn't move.

Long after she glided out of the module her perfume lingered in his nostrils. Eventually it dissipated enough for his mind to clear. A terrible pressure filled his chest and groin as he put that family picture away. Still trembling, he placed the headphones floating nearby back on his ears. The florid coloratura aria "Der Hölle Rache" pierced his brain.

Stone savagely stabbed the player's "Stop" button. He'd had enough of the Queen of the Night already. An exchange of chips brought the opening strains of another opera—*Fidelio*.

Outside, Earth lay cold and still in unending darkness.

Much later, in the stillness of the first faint trumpet call announcing the arrival of Don Fernando at the prison-fortress, Stone heard a muffled voice over the intercom. He removed his headphones.

"—need you! Stone, come here!"

He pushed a button. "What do you want?"

"It's Boris! He's sick! We need you in the galley *now!*"

"On my way."

The nausea returned as Stone hurriedly pulled himself through the intervening passages. Ashen and sweating, he plunged down into TransHab—

And fell into a Hieronymous Bosch painting. Faceless naked bodies tumbled chaotically around him in semidarkness. The acrid smell of sweat and other body odors overwhelmed him. For a disorienting moment he didn't know where he was or what was happening.

Gradually his brain created order from this nightmare. The blurred faces focused into those of his five crewmates—their clothing scattered like drifting clouds around the claustrophobic module. Vali's wadded-up negligee brushed his arm. Then its owner, dressed only in shredded fishnet stockings, floated forward to face him. Again his senses reeled, stunned by the Praxitelean beauty of her flawless figure.

Another instant and that compartment of his mind crashed shut like a bulkhead. Instead of the man's desire to touch and kiss those roseate nipples nearly touching his face, the physician saw only two suspended masses of glandular adipose tissue.

Lipstick smeared over her cheeks, hair braid half unknotted, Vali motioned him toward the elderly grimacing figure

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hunched over the zero-gee toilet. Boris was pale, diaphoretic, and gasping for air. His bricklike fist was pressed against his sternum.

"Boris, what's the matter?"

The Russian looked up at Stone miserably. "There's a terrible pressure in my chest. It won't go away!"

"When did it start?"

"About ten minutes ago, right after my turn with—"

Vali hovered close to Stone, a worried expression darkening her face. A loose strand of her hair tickled his cheek. The doctor coldly nudged her away with a flick of his shoulder—sending her gliding away from him and his patient.

His eyes tracked down Newkirk, drifting nude nearby. "Get the portable oxygen setup!" Then he turned and glared at Morita, who'd snatched his underpants from midair and was struggling back into them.

"Get over here!"

The station's other Crew Medical Officer gave up on redressing and obeyed, his twisted undergarment hanging around his left ankle like a white flag.

Stone shouted, "We've got to get Boris to the Health Care Area. Get the backboard."

"Can't we just float him there now?"

"Don't want to risk it. Once he's wrapped on the backboard, we won't have to worry if he starts fighting us."

Stone checked Boris's radial pulse, and frowned. The Russian looked at him pleadingly. "Is it something serious, my friend?"

"I don't know. I hope not. But I'm not taking any chances."

Morita stood the long backboard upright, and Boris painfully stretched himself out to help them position him against it. Long cloth flaps enfolded most of his body, secured by Velcro straps. Newkirk returned with a clear plastic mask and tubing connected to a small oxygen tank. Stone positioned the mask on Boris's face and turned the oxygen flow to four liters/minute. After several breaths the latter said, "I feel better."

"Good."

As Stone opened his mouth to tell the others to start moving Boris, something wet splattered against his cheek. He wiped it away, then rubbed the viscous droplets with his fingertips until he realized what it was.

Semen. More globules floated nearby.

He gritted his teeth at LeBeau, cowering silently at the far end of the module. "Get a handvac and suck that stuff up before somebody chokes on it!"

Stone watched grimly as Morita and Newkirk pulled Boris "up" two levels to TransHab's medical suite. They secured the backboard to a wall, leaving his arms free and accessible. As Morita reconnected the mask to a larger oxygen supply from a wall outlet, Stone clipped a pulse oximeter to Boris's left index finger and wound a crackling blood pressure cuff around his upper right arm.

The Russian winced as Morita shaved mounds of gray hair off his chest and applied sticky white electrode patches to its raw skin, and each arm and leg. He watched Stone frown at the flaming red numbers a nearby screen displayed. "What do they mean, my friend?"

Blood pressure 115/60. Heart rate 110. Respirations 20. O_2 *saturation 96%.* Nothing critical—but not entirely normal either.

"Don't talk. I need to listen to your lungs and heart."

Thirty seconds later Stone removed the stethoscope from his ears. *Lungs clear. No murmurs or gallops, but many irregular beats.* He barked at Morita, "Get him hooked up to the monitor!"

The latter hurriedly attached the last wire to the electrode patches. A rapid high-pitched "beep, beep" echoed in the module in time with a bouncing green line on an LCD screen. Stone's forehead furrowed. *Lots of PVCs.*

"Get an EKG. Then start an IV with D_5NS at KVO."

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Morita pushed a button on the console, then wrapped a tourniquet around Boris's left arm. Stone watched a twelve-lead electrocardiogram displaying the electrical activity of the Russian's heart play out on the screen. He scowled, "That doesn't look right. Check the leads."

Morita pressed the electrode patches and jiggled the wires stuck to Boris's skin. "Seem OK to me."

"Print a hard copy."

Glossy paper divided into tiny pink boxes rolled slowly out from a printer. Stone snatched the paper, stared in disbelief at the pattern of blue squiggles on it—and felt sick. He released the EKG, letting the Russian's potential death warrant drift away. "Get that IV in *now!*"

Morita swabbed Boris's forearm with an alcohol pad and jabbed a plump vein with a needle. He grunted with satisfaction as a bead of ruddy blood formed at its free end, slipped a short plastic catheter over the needle into the vein, and connected it to the clear IV tubing and bag suspended beside him.

Stone rummaged through a drawer of medical supplies and yelled at Morita, "Pump the pressure bag up! That fluid's not going to flow without gravity!"

The latter squeezed a black rubber bulb repeatedly, sending air into a sealed bladder surrounding the bag of IV fluids. It compressed the bag—forcing the dextrose and saline solution into Boris's bloodstream.

Stone turned to Newkirk. "Patch me through to a flight surgeon!"

Kicking his naked legs, the other man disappeared as he headed toward a communication console. Boris winced as Stone ripped several electrode patches from his chest, slapped on two considerably larger ones in their place, and reapplied the smaller patches around them. "Is your chest still hurting, Boris?"

"Some."

"Open your mouth."

Stone placed a tiny white tablet under the Russian's tongue.

The latter grimaced. "That pill burned."

"It's supposed to! Now chew this aspirin tablet."

Boris massaged his chest—wondering how mere aspirin could ease the terrible pain there.

Newkirk's voice boomed at Stone from the intercom. "JSC's on the line. They'll patch Mina Osler through to you in a minute."

"Good, she's an internist."

As Stone connected a cable between the two large patches on Boris's chest and the defibrillator, Vali floated into the module. She'd dressed back into standard-issue blue top and shorts. Stone deliberately ignored her as he reached for an ampule of morphine. She glided beside her husband, and stroked his grizzled cheek with wifely concern. "Feeling better?"

Boris grinned weakly. "Don't worry, my love. Dr. Stone's taking good care of me. I'm feeling fine now . . ."

His eyes rolled back, lower jaw slack. The shrill alarm tones from the EKG monitor made every conscious eye in the room twist toward it.

"*Get away from him!*" Vali cringed at Stone's order, but moved away as he hastily set the defibrillator to 200 joules. He shouted at Morita, "Check his carotid!"

The defibrillator squealed as Stone stabbed the "Charge" button.

Morita's fingers kneaded the side of Boris's neck. "I can't feel any pulse!"

"Then get back!"

Morita pushed off the module's side, grabbing Vali's arm as he went and dragging her away with his momentum. "What's wrong?" she stammered.

Stone rechecked the monitor, making sure the jagged chaotic complexes racing across it were unchanged. Though the others were well away from Boris, he reflexively recited, "I'm clear, you're clear, everybody's clear!" Then he pushed the defibrillator buttons.

Boris's body convulsed as the electric

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current arced through his chest—arms flailing upward in a gesture of supplication, and staying there. Stone sighed thankfully as sinus rhythm reappeared on the monitor. His fingers moved to the Russian's neck, then his other hand started a blood pressure measurement.

"Good pulse. Looks like he's breathing OK."

Morita moved back towards Stone. "Should we intubate him?"

"Not yet. O_2 sat looks all right. Let's see if he wakes up."

Boris snorted. "Did I fall asleep?" He winced at Stone. "The skin on my chest feels like it's on fire."

"I'll give you something for it."

Vali tentatively floated back toward them. "What did you do to Boris?"

Stone sneered at her. *What kind of medical training did they give you?*

Newkirk's voice returned over the intercom. "Osler's on the line."

"Stone here. Mina, are you there?"

"Yes, what's going on?"

"Boris developed angina about twenty minutes ago. We moved him to the Health Care Area and got an EKG. I'm transmitting it now."

Seconds later Osler exclaimed, "Holy Mother of God! How's he doing?"

"He's alert, vital signs are OK. We'll set up the full telemedicine link with you so you can get our readings."

"What have you given him so far?"

"One sublingual nitroglycerin and a chewable aspirin tablet. He just went into VT at a rate of about 300 and lost his pulse, but came out of it with one shock. I'll load him with amiodarone."

"What about giving him tenecteplase?"

"I don't know yet. Let's get another EKG and see if his ST segments are coming down before we decide on thrombolytics. Based on how he does, we'll have to think about evacuating him."

Osler groaned. "Don't even *mention* that right now. We've got to stabilize him first! I can't believe this is even happening. There was nothing in the medical records the Russians sent us to indicate Boris was having any problems preflight. Was he doing anything unusual before it happened?"

Stone glared at Morita and Vali—coldly reading the fear and pleading on their faces. *Yes, he and the rest of these so-called professionals were having an orgy!*

"He was—performing a moderate level of exertion. Maybe 5 METs."

He pressed a button. "Here's the next EKG."

Stone's heartbeat slowed a bit as he studied the paper the printer spat out. Osler said, "Looks better—no more 'tombstoning'—but he's still got nearly 2 mm ST elevations in V_1 through V_5."

"His heart rate and blood pressure are still good enough for morphine and atenolol. Let's try them before we go with tenecteplase."

"OK. I'll contact the Russians to see how they want him treated—and about evacuating him."

"Fine."

As Morita finished administering the medications Stone ordered, Vali said, "What's wrong with Boris?"

The cardiologist ignored her. "Is your chest pain better, Boris?"

"Yes. But what is wrong with me?"

"You're having a myocardial infarction—a heart attack. Your EKGs indicate a blood clot's blocking the artery that supplies blood to the front of your heart. That's why you've had chest pain, and went into that abnormal heart rhythm—ventricular tachycardia—we had to shock you out of."

"How could that be, with all the exams and tests you and the other doctors have done on me?"

The Russian paled. "Could . . . what we were doing a little while ago have caused it?"

Morita and Vali cringed as Stone sneered at them, his voice like ice. "What do *you* think?"

Then, to Boris, "We're trying to decide which medications are best for you. One of them might dissolve the clot. But

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it'll also increase your chance of bleeding elsewhere in your body—and our supply of blood substitute is limited. If we were at a hospital on Earth, you'd be getting a cardiac catheterization right now instead. I'd thread a thin tube through an arm or leg artery up to your heart, and open the blocked heart artery by inflating a tiny balloon inside it. Then I'd insert a small tube—a stent—to keep the artery open."

Vali whispered, "Will he be all right if he doesn't have that done?"

Stone focused on his patient. "I'll do the best I can with everything I have here. I hope it's enough."

Stabilize and transfer. That medical mantra was scarred into Stone's memories. Ages ago, during his cardiology training, he'd spend countless weekends moonlighting in ERs at small community hospitals in rural Texas. Patching together and pumping medications into mangled auto accident victims barely clinging to life, until they were stable enough to survive the airlift to an urban medical center, with the specialists and equipment needed to give them definitive treatment—and save their lives.

Stabilize and transfer. A fine principle—usually. But when reaching that life-saving care meant a fiery descent from orbit, and suddenly thrusting a fragile heart back into the stress of 1 *g*—maybe it was better to leave bad enough alone.

Osler returned and finished her update. "Everybody down here—including the Russians—agree you should give Boris tenecteplase and enoxaparin and then, if he's reasonably stable, get him down here to JSC right away. We can have him at St. Luke's forty minutes after you land."

"It might be the lesser of two evils to keep him here. If he has more VT or goes into cardiogenic shock while we're deorbiting—"

"I know. But if he stays on the station, you don't have all the medicines and equipment you need to treat those problems *there* either! Still—you're in the best position to see how he's doing. I'm afraid you get the final call about when—or if—we try getting him home. I'll sign off and get everything ready here, in case you do decide to bring him down."

Stone sighed. *Not that I want that responsibility.* "OK."

Vali held her husband's hand as Morita drew the blood samples Stone ordered. After the biologist left to analyze the specimens, the physician injected several more medicines into his patient. Finally he said, "Boris, we have to decide now. If we keep you here, and a couple hours from now you have more chest pain, or even—"

"Die?"

Stone nodded. "If that happened, we'll wish we'd evacuated you. But if we send you down on the CRV, and you have problems en route—"

"Then, my friend, you'll curse yourself for doing *that*."

The Russian shrugged resignedly. "You're the doctor. Tell me what you think is best, and I'll do it."

"Medically, it's too close to call. *If* we get you safely to a hospital on Earth, your chances of getting through this will be better than they are now. But that's a big 'if'. And it's *your* life at stake, so I need to know what *you* want to try."

Boris placed a hand on the doctor's shoulder. "If you think it's better for me to go to Earth, then that's where we must go."

As Stone began "That's not what I said—," an unexpected voice interrupted him.

"Newkirk's getting the CRV ready."

LeBeau, attired in a fresh jumpsuit, had recovered his usual jauntiness. "He said it'll take at least four hours to finish repairing the communication system Boris was working on, so you'll use the other vehicle."

"I still haven't decided whether Boris should be evacuated."

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"Well, decide now. You'll need to leave the station in thirty minutes to be in the best position to deorbit and land at JSC. If not, you'll have to wait another orbit before you're in prime position to leave again."

Stone hesitated. During his career he'd had to make many quick life-and-death decisions on critically ill patients when there wasn't enough information to tell him what the best one was. The scientist in him hated extrapolating beyond the data points. But sometimes you had to make a leap of faith—and go with what your *instincts* told you was right.

Finally he said, "Let's do it."

"Good. I talked Houston out of having all of us leave the station. You only need one person to go with you and Boris, to pilot the CRV."

"Morita can't go. With me gone, he's your only fully-trained CMO."

"And I, as mission commander, should stay too."

"Then Newkirk's the logical choice—"

"*No!*"

Vali and Boris shouted the word simultaneously. The latter said, "I want her with me, otherwise I won't go!"

Stone turned to LeBeau. "Newkirk's better qualified. If we have any major problems with our systems in-flight, he's fully trained to make repairs. She isn't."

Vali protested, "But Boris needs me with him! I'm his wife!"

"Yes, I won't go without her!"

Stone snorted. *How touching. Such a devoted couple.* "Whatever. She can come along for the ride—*if* Newkirk comes too."

The commander stroked his chin. "There's no need for four people to leave. I'm more familiar with Vali's training than you. I believe she's perfectly qualified to pilot the CRV. And *I* understand why she wants to go."

"*My* first concern is getting my patient safely back to Earth. Let's see what JSC says—"

LeBeau waved his hand impatiently. "There's no time for that. *I* am in charge here. We'll do it my way!"

Stone swallowed his rage and forced himself to think. He glanced at the monitor, then at Boris—the innocent victim caught in the middle of this senseless argument. Fighting LeBeau's pigheaded idea would waste too much time. Appealing to JSC might also take too long—even if they agreed with him, the first opportunity to deorbit might be lost. And if Boris took a turn for the worse during those precious minutes before their next chance to evacuate him—

The doctor shouted, "Have it your way! Let's get Boris to the CRV *now!*"

The hatch above Stone clanked shut. Though the dimly lit CRV held only three of the seven people it was designed to accommodate, he still felt claustrophobic—like they'd just sealed his tomb.

Boris was strapped into one of the four seats forming the back row of the vehicle. Its nearly five-meter-wide interior was a comforting hospital-white. Special compartments and attachments in the CRV's rear held the medical supplies and portable equipment needed to support his patient on the way down.

Stone increased the infusion rate of Boris's D_5NS, and checked the wires and tubes tethering the Russian to a monitor and defibrillator plugged into the craft's power system. *Vital signs look good, EKG's almost back to normal. No Q waves yet. So far—so good.*

Boris smiled at him. "Don't worry, my friend. We'll all be fine."

Wish I could believe that. "The way things are looking, the tenecteplase you got might've at least partially dissolved the blood clot blocking your heart artery."

"And I feel almost well enough to go back on duty! Maybe we don't need to leave—"

"It's not that simple. For the next twenty-four hours, even with the amiodarone you're getting, that abnormal

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heart rhythm we shocked you for has a good chance of recurring. And for the next couple *days* there's another serious risk. Probably you had a small blockage—a plaque—in your left anterior descending artery that was too mild to show up on routine tests. It ruptured, and blood clotted over that injured area."

"Like it does on your skin, when you cut yourself."

"Something like that. But because your ruptured plaque still hasn't healed, until it does, *another* blood clot could form there—giving you more chest pain and heart damage."

"So I could still die."

"Not if I can help it!"

Stone withdrew a liter bottle of Astroade from a supply chest and pulled himself dizzily toward the front of the CRV.

"Drink this."

Vali, strapped into the middle of the three front row seats, frowned at the computer screens and data displays on the instrument console before her. "In a minute. I need to study these readings—"

Stone thrust the bottle at her. "Take it!"

"But why—"

"You lost about a liter of fluid from your bloodstream after entering microgravity. Some of the remaining fluid shifted from your lower to upper body. If you don't replenish it, after we land Earth's gravity will pull too much blood back to your legs when you stand. Then your brain won't get enough blood—and you might pass out."

Vali took the bottle, and pressed her lipstick-smeared mouth around its nozzle. She squeezed it, and lingeringly gulped down its contents. "Why aren't you drinking any?"

Stone scowled, and patted his upper thigh. "Because *my* body's still adapted to 1 *g*. The negative-pressure trousers I'm wearing kept me from losing that fluid. I'll just have to neutralize the pressure after we deorbit."

In a shadowy recess of his mind a shrill voice sneered, *I wasn't anything special to you! You wanted the others too!*

From the console, LeBeau's voice crackled, "Two minutes till disengagement."

Stone strapped himself in beside Boris, leaving Vali alone in the front row. As the seconds ticked by, shame at his thoughts and behavior seeped into his mind—melting some of his anger. Of course it didn't matter whether Newkirk or Vali came. The CRV's re-entry sequence was fully computer-controlled and automatic. Its inertial navigation system used data from Global Positioning System satellites or transmitted from the ground to direct the craft to the right place in orbit, fire the Deorbit Propulsion Stage's engines to slow it for re-entry, then jettison the DPS.

Their unpowered vehicle would glide down like a Shuttle until, at an altitude of about five kilometers, it deployed two secondary parachutes and a large parafoil to slow it down. Then the Navigation Guidance and Control System would guide the parafoil autonomously—turning it as needed to keep them on course to JSC. Finally they'd slide to a soft pinpoint touchdown on the craft's retractable landing skids.

All routine, all perfectly safe. Because the electronic systems in CRVs never failed. And parachutes always deployed properly.

"One minute to disengagement."

Stone wriggled in his seat—trying to think happy thoughts. In another hour, he'd be home. Hopefully the family liaison people at JSC knew where to reach Donna to tell her what was happening. She and the kids, halfway through their Christmas vacation, were out of town in Cincinnati visiting her parents.

But maybe it was better if she *didn't* hear he was returning early. During their telephone link several days ago, Donna said a blizzard had made the city's

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Christmas all too white. Knowing her, no matter how bad or dangerous the weather was, she'd try flying—or, if the airport was shut down, maybe even driving back to Houston to be with him. *Her* chance of getting hurt or killed in an accident on the way there might be more than his.

Think something happier. Shortly after they landed, Boris would be tucked safely into an ICU bed at St. Luke's. There he'd have all the doctors, nurses, and state-of-the-art medical care he needed to get well—and wouldn't be only *his* responsibility any more.

Except—this was Boris's farewell to space. Whatever caused his MI, they'd never clear him to fly again.

And—maybe—it was his farewell too. Back home with his family after these long months, this time he might not be able rationalize leaving them again. Maybe it was finally time to renounce Luna, his harsh mistress.

A melody from *Dr. Zhivago* waltzed through his mind as the CRV silently separated from the ISS. A small LCD on the wall beside him showed a shielded minicamera's view of their windowless craft moving slowly away from the huge, dark, spider-like structure.

Stone saw Boris stare transfixed at the screen. A tear trickled down the burly Russian's cheek as he murmured, "Farewell."

Vali turned around to look at her husband. Her eyes misted over. "I'm sorry, my love!"

Squirming uncomfortably, Stone studied the monitor showing his patient's vital signs and EKG. For many minutes a profound quiet enveloped the cabin, punctuated only by the faint chatter Vali kept up with JSC, and gentle vibrations as thrusters fired and maneuvered the CRV into position for its deorbit burn. The ISS dwindled in size, then disappeared from the screen. Now it was just the three of them—alone in a lifeboat bobbing in the vast black ocean of space. The cardiologist chuckled grimly at his memory of Alfred Hitchcock's cameo in a newspaper weight-loss ad.

Vali murmured, "Deorbit burn in ten seconds."

Stone glanced worriedly at Boris. In theory, the deceleration forces during the DPS's big burn should put little additional strain on the Russian's cardiovascular system. Neither should the slightly more than 1 *g* they'd experience during re-entry itself. But, in his present condition, even what would normally be a trivial stress might prove life-threatening.

"Five seconds . . . two, one . . ."

Stone braced himself for a rumble and shove that never came. Instead he heard a sharp *SNAP!*—and the lights went out.

In the terrifying darkness Stone reflexively placed his palm over his heart—checking if he was still alive. The curses in Russian bellowed beside him, the "beeps" and dimly lit screens and displays of his medical equipment—now the CRV's only illumination—finally reassured him of his continued existence.

At least for now.

Vali was first to shout what they all recognized. "Total power failure!"

Stone felt Boris try to lunge forward before being stopped by his seat restraint. The Russian roared, "There is a flashlight in that compartment on the left side of the console!"

After long seconds of metallic clanking from the CRV's front, Vali exclaimed, "I found it!"

Boris yelled back at the wavering light that clicked on in front of him, "Check the batteries!"

Then Stone smelled it. An acrid smell—like burnt insulation. Not a good sign.

Next it was Vali's turn to spit curses in Russian. "The batteries—they all look charred, like they shorted out!"

Boris called back, "All of them? Impossible!"

"But they are!"

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"I must see them!"

Stone squelched his flashback of scenes from *Apollo 13* when the shadowy figure beside him tried to tear off the tubes and wires attached to his body. "Boris, stop it! If you don't lie still you could die!"

"If we don't get power back, doctor, we're *all* going to die!"

Suppressing his medical reflexes, Stone grumbled, "All right. But let me disconnect you the *right* way. If you yank out your IV lines we'll be swimming in blood—*your* blood!"

The Russian waited impatiently until the physician finished, then rocketed forward. Stone shut off his medical equipment, the glowing lines and numbers on their displays now meaningless with no patient attached, and followed more cautiously—guided by the flashlight darting frantically in front of him.

Boris moaned, "This is bad."

Stone dimly saw him attach a multimeter to different sections of the craft's bank of batteries. Then Boris pronounced his diagnosis.

"They're all dead."

Then so are we. With a clinical detachment that surprised even him, Stone pictured himself dead. Dealing with death and dying for so long as a doctor numbed some of the regret he felt for himself.

But he grieved for those he loved. Having a dead "hero" for their husband and father might bring them some consolation. But what about all the "might-have-beens"—the birthdays, holidays, even the experiences most taken for granted, like feeling his wife pressed warmly against him on a leisurely Sunday morning after they'd made love, that he wouldn't be there to share with them?

Vali whispered, "Is there anything we can do?"

Her husband murmured, "We have one chance—"

His flashlight flailed wildly in the darkness for a while. Then he yelped, "Good! The spare battery modules are fully charged! Vali, help me replace these bad ones!"

Stone sighed. Thank goodness for NASA's insistence on redundancy—even for components that no one realistically expected to fail completely.

Except—he was a doctor, not an engineer, but he vaguely recalled something from those basic courses on the CRV even he'd had to take.

"Boris, do we have enough spare batteries to replace *all* the ones that are dead?"

A pause. "No. Only two of them."

"Do we have enough power for the systems we need to get down in one piece?"

"That's what we must talk about . . ."

In the near-darkness, clustered around the glowing flashlight like teenage campers telling ghost stories, the three of them floated in the center of the CRV and—almost literally—put their heads together.

Boris began, "I'm not sure, but I think we have just enough battery capacity to reach Earth—if we're careful how we use it. We *have* to fire the DPS, we *have* to use our navigation system to plot our location—and the computer *has* to release the parachutes at the right time."

Vali nodded. "You and I trained to maneuver the parafoil with manual controls if the NGCS failed. That would save a little power."

Stone added, "The life-support system. Normally we'd have enough supplies and power for nine hours with a full crew. With only three of us, our oxygen supply will last longer. But, without an operating thermal control system, over the next few hours it'll get uncomfortably hot and cold in here."

Boris laughed. "*I* don't intend to be up here a few hours from now! I estimate we'll be in the right orbital position to try another deorbit burn in about one hour."

Vali frowned. "What about communi-

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cations? Shouldn't we try to contact the space center, or the station? They could give us advice."

Her husband shook his head. "If we had enough power to spare, I would. But we don't—and I doubt they could help us anyway."

"What about returning to the station?"

Boris looked at Stone, and sighed. "All this time, our orbit has been slowly decaying. I fear we're too far away from and below the station now to rendezvous with it. And it'd do no good if they came to us in the other CRV. These craft are not designed to dock together—and we don't have the suits for an EVA!"

Stone shrugged. "At least now we have a plan."

"Except . . . I wonder if—"

Both men turned their heads in Vali's direction.

"Doctor, didn't you say a blood clot blocked an artery in Boris's heart, and deprived it of blood?"

"Yes."

"Well, that reminds me of how our batteries suddenly failed, and shut down our power."

"I suppose, but—"

"Don't you see? Maybe, just as that blocked artery damaged Boris's heart, whatever destroyed our batteries—perhaps a short circuit, Boris?—also damaged a computer or other system we need to get home. Or maybe your giving medicines that partly dissolved the clot is like us using these replacement batteries."

Boris nodded. "Do you understand what she's saying, my friend? You said the same problem that blocked my artery could happen again. And if whatever damaged the original batteries destroys these replacement ones too . . ."

Stone said nothing. There was nothing to say.

Stone watched anxiously as his two crewmates, sitting beside him in the front row of seats, applied power just long enough to run diagnostics on each of the craft's critical systems. As each computer and display flared briefly to life and Boris murmured approvingly, the doctor breathed another sigh of relief. If any critical system *didn't* work—*couldn't* be repaired—well, it would take only *one* weak link in the chain to kill them.

As he waited for their last flicker of hope to be extinguished, Stone remembered something the Machiavelli-reading LeBeau said. *Newkirk's getting the CRV ready.* Now he wondered if that preparation included sabotage. How convenient, if the one person who might squeal about their extracurricular sexual activities suffocated in space—

Boris's forehead beaded with sweat. "Now for the last test—our navigation system."

Stone shivered—but not simply from fear. With their heaters not working, he could see Boris's breath. Based on how cold the cabin was, they must've been in Earth's shadow for a while.

But he felt warmer when Vali exclaimed, "It works!"

Her husband kissed her cheek, then whooped as numbers flashed on the console's screen. "The GPS is showing our position! At least now we know where we're lost!"

Vali's fingers flew over a small keyboard. She exclaimed, "In sixteen minutes, we'll be in the right place to fire our engines!"

"Now we know everything we need to!"

Boris flicked a switch, and the cabin went dark again until Vali turned on their flashlight. "We'll reactivate these systems three minutes before we reach our deorbit point. That will—I hope—give us enough time to make sure everything's still working and update our readings, while wasting as little precious power as possible."

Stone interjected, "How far away are we from the terminator?"

"We've already passed it. Though we

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cannot see it, the Sun is shining on us!"

"Good. Then it should start warming up in here soon."

"Let's hope it does not get *too* warm. If our deorbit engines don't fire properly, or we re-enter the atmosphere at the wrong speed or angle—"

Stone completed the sentence silently. *We burn up.*

He said, "Boris, let me hook you back up to the monitor and defibrillator."

"I'm afraid I can't do that, my friend. I may need to move around quickly to recheck the batteries if anything goes wrong during our descent. I cannot have your medical devices weighing me down like anchors!"

"But your body's going to be stressed during deceleration and re-entry. If I can't monitor your blood pressure, EKG, and other data, I won't be able to treat you effectively!"

The Russian shrugged. "I must take that chance. Your medicines have done a wonderful job. I feel fine now!"

"*Feeling* fine doesn't necessarily mean you *are* fine. Back on the station you were 'feeling fine' just before you went into VT! If we hadn't already connected you to the defibrillator and shocked you immediately—"

Boris shrugged. "I suppose I'd be dead now. Perhaps it would have been better if I'd died on the station. At least then Vali and you would still be there—and safe."

In the darkness Stone heard Vali, seated to his left, lean away from him toward her husband. He only heard the kiss she gave him. "Don't say that, my love!"

Boris murmured soothingly to her, then raised his voice. "There's something you *can* do for me, doctor."

He angled the flashlight so it gently illuminated Valentina's face. Her makeup was nearly rubbed off, and her hair was a tangled mess floating haphazardly behind her. The grimy jumpsuit she wore flattened and neutered her figure.

Stone went rigid as Boris continued. "I know, my friend, you've been angry at Vali. You don't approve of certain ways she's chosen to live her life. Not because, as that fool LeBeau thinks, you have no human feelings. No, though you hide it well beneath that hard doctorly crust, you care very much about people—perhaps too much. It hurts, even angers you when they do things to themselves you think are harmful—or that won't make them as happy and healthy as they could be. And it frustrates you when you can't help them see, or do what you believe could bring them much greater joy and fulfillment.

"Perhaps Vali and I have sacrificed things we shouldn't have—like a warm, loving home, with children scurrying about. Perhaps the ways we choose to soothe and quench our loneliness aren't the best. But, if we are to pursue our greatest love, we must be faithful only to it."

Boris delicately nudged Vali's cheek away from him, until she was looking at Stone. "Tell him, my beloved. Tell him why you made love to me, and all those others on Earth."

Stone stiffened as the woman beside him hesitated. Then she murmured, "Because I *had* to. It was the only way I could get into space. When I was a little girl growing up near Kursk, I'd go out on cloudless nights and look up at the round bright Moon hanging over the wheat fields. I'd dream about being the first Russian, the first woman to stand on it—to look back at the tiny Earth hanging suspended in velvet, and see how far I'd come, how much I'd achieved!"

Her eyes shimmered with starlight, and the vast wondrous expanses of the universe. They reminded Stone of a seven-year-old boy squinting through the blurry eyepiece of a rickety department store telescope—straining beneath a cold night sky to glimpse the canals of Mars.

Boris smiled. "You see, my friend, we all have something more in common

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than sharing this predicament. And if we survive this, I want you to do something for me."

"What?"

"*Don't* do or say anything that will keep Vali from living her dream! There will be questions about what everyone was doing when my heart failed me. If you tell them the truth, it will cause a scandal, with shame and disgrace for the rest of us. Perhaps *their* space agencies will eventually forgive our three absent 'friends' on the station, and let them go back into space—if only for missions no one else wants.

"*My* government will not be so understanding. It doesn't matter what happens to me. My body has failed me, and I *cannot* fly again. But it would break whatever is left of my heart if Vali were, as you say, 'blackballed'. For *her* to stay bound to Earth for the rest of her life would be death by lingering, perpetual torture."

Boris chuckled dryly, and pressed his fist over his breastbone. "Humor a dying man. Grant his last request—promise me you won't say or do anything that could hurt Vali!"

Stone hesitated. "There are other issues involved, Boris. Lying about what happened might make things worse."

"I am not asking you to lie, but merely be . . . discrete about what you say."

"I'll—do the best I can."

Boris sighed. "I suppose that is the most any of us can be asked to do."

Minutes later, at Boris's signal, Vali flicked the first switch. One after another, a firecracker cascade of glowing computer screens and readouts illumined the console.

Although, like everyone assigned to the ISS, he'd been trained to operate the CRV, Stone let the two Russians do it. Watching them work, Boris—and yes, Vali too—clearly knew what they were doing. His efforts were better directed observing Boris—alert for the first sign his patient was taking a turn for the worse.

Vali murmured, "Deorbit burn in thirty seconds."

We hope. Stone watched Boris point to a vertical bar meter on the console. "We all must watch this meter very carefully. See how it's glowing just a little into the yellow area? Even now you see it creeping down toward the red, as we deplete our batteries' power. To conserve it, we must shut off each system as soon as it has done its job, and is no longer needed. For if this meter stops glowing before we reach the ground—"

Splat. As he leaned back, Stone felt like he was in a dentist's chair. A flashback of that family vacation to Yellowstone two years ago made him squirm more. Driving at night through a lonely stretch of Wyoming, he'd shaken off his highway hypnosis to realize the minivan's gas gauge was pointing perilously close to "E". With no artificial lights behind or ahead of them under that cold starry sky, he could only hope—or pray—there was a gas station just beyond the black horizon. And while the kids slept in back, he and Donna discovered their cell phone's battery was dead—with no replacement or way to recharge it.

Whether divine providence or merely luck, they'd made it to that lonely ramshackle station driving only on fumes and will power. Even paying four dollars a gallon beat being stranded in the middle of nowhere—with slim prospects of rescue. Maybe his idea of wiring the cell phone directly to the car's battery with jumper cables might've worked. More likely the phone would've just been fried—

"Five seconds . . . two, one . . ."

Stone braced himself for the console to go dark again. But instead an invisible mattress pressed him back into his seat. The craft rumbled around them like a runaway vibrating bed as Vali recited, "Deorbit burn 25% complete . . . 50% . . . 75% . . . complete!"

The mattress vanished. Boris mut-

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tered, "Now let us pray this clever computer jettisons our engines!"

As if in answer, the craft jerked forward slightly, and a green light lit on the console. As Boris blurted "Thank you, dear God!", Vali flipped several switches and reported, "Everything is shut down except the navigation system."

Her husband frowned at the meter. "Perhaps I thanked the Almighty too soon. We're deeper into the red than I hoped."

As the CRV performed its preprogrammed turn and plunged into the atmosphere, three pairs of eyes anxiously stared at the solitary lit display on the console. Watching their altitude and distance to the landing site decrease, seeing the meter dim—and hoping the thin lifeline they clung to wouldn't snap.

Stone listened as Vali slowly counted out numbers. "Altitude 100 kilometers . . . 90 . . ." Then he glanced at Boris—and his own heart skipped a beat. The other man was pale and diaphoretic. His breath came in gasps, and his fist rested on his chest.

"Boris, what's wrong?"

The Russian exhaled a huge sigh. "We did our best. But . . ."

His moist finger stroked the meter. Only a sliver of red at the bottom warmed his fingertip.

Vali stopped counting and clutched her husband's hand as he said, "The batteries will probably be exhausted about the time our parafoil must deploy. If they fail before it does—"

Stone interrupted. "The parafoil *won't* deploy, and—no pun intended—we drop like a stone. Of course, if we're lucky, they fail after the parafoil's out. Except—with no navigation system to tell us our location, we'll be flying blind. Not that it'd matter anyway—with no electricity for the automatic or manual systems, we can't steer the parafoil and control where we land. Let's hope we don't take out a chunk of downtown Houston with us."

The two Russians' eyes widened at their crewmate. The doctor sighed. "Sorry. I shouldn't have said that."

Boris groaned. "But it *is* the truth."

Vali brushed perspiration from her husband's forehead. "If we only had another battery . . ."

Boris didn't reply. His face was ashen—and it seemed he might not live long enough to matter how he reached the ground. Stone grimaced, thinking it wouldn't have made any difference if he'd talked his patient into hooking him back up to the defibrillator—

Suddenly he shouted, "Wait, we do have more batteries!"

Vali screamed "*What?*" followed instantly by Boris's "*Where?*"

Stone replied, "I use portable medical equipment so much, I take for granted they have backup power systems inside them for when they aren't plugged in! Your monitor and defibrillator—*they* have good-sized batteries inside them!"

Doubt shaded the new-found hope on Vali's face. "But are they the right kind of batteries? Will they work?"

Suddenly rejuvenated, Boris replied grimly, "I'll *make* them work!"

As Vali resumed her countdown ("Altitude 50 kilometers . . . 40 . . ."), Stone unstrapped himself and followed Boris to the back of the CRV. That end of the craft now was—and *felt*—tilted downward as Earth's gravity brought weight back to their bodies. As Stone held the increasingly heavy devices, Boris unscrewed their back panels and ripped out their small but powerful batteries.

Struggling "up" to the front of the craft, Boris laid on the floor beside the left side of the console and braced himself against a wall. Stone held the precious batteries while the other man fumbled for cables and tools. As he watched Boris's hands flying inside the tight compartment, pausing only to snatch another battery from him, he seemed to catch fleeting images of Mir in his crewmate's eyes.

Vali's murmured "Altitude 20 kilometers . . ." was interrupted by a thunder-

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ing voice below her. "Any change on the meter?"

A pause. "No. Ten kilometers—"

Boris cursed, and jiggled a cable. "Now is it changing?"

"No . . . wait, the reading's higher!"

Stone glanced up too. There *was* more red showing—but not much.

Boris wiped his brow and accepted the doctor's helping hand to pull him up. "Nothing more we can do. Let's hope it is enough."

They strapped themselves in on either side of Vali. She murmured, "Six kilometers . . ."

Stone felt himself jerked upward as the CRV rocked. Vali shouted, "Drogue chutes deployed—"

A bigger lurch turned his stomach upside down. Through his nausea he heard Vali cry, "Parafoil out!"

A weak voice on the opposite side of the cabin answered, "Shut down the automatic guidance system and use manual controls. They need less power."

Vali obeyed, using their position display to guide her as she steered the parafoil to keep them on course. She whispered, "Ten kilometers from target . . . nine . . . eight . . ."

Stone pictured the huge fluorescent orange parachute unfurled above them—hopefully carrying their dead weight safely down to Ellington Field. Belatedly he wondered if JSC knew they were coming in. They'd been out of communication for nearly two hours—

A groan interrupted his reverie. Boris was lying back in his seat, eyes closed. "Boris, are you all right?"

No response.

Not now! As Stone struggled free of his seat's restraints in the bobbing craft, Vali's concentration wavered from her task. "What are you doing?"

"I have to help Boris!"

Feet spread wide for balance, the doctor twisted around and behind the row of seats—using their backs for support as he struggled to reach his patient. Falling back, pulling himself forward in the swaying ship with Sisyphean tenacity, he stretched to get close enough to see if Boris was breathing—if he still had a pulse.

But what if he didn't? Doing CPR was impossible when he couldn't even get a stable foothold! There was no monitor to guide his treatment, no medicines to give, no defibrillator to shock the Russian out of VT—!

Stripped of his technology, skills, and reason, Stone grabbed Boris with both hands and shook him violently. Drowning out Vali's quiet "Five hundred meters . . .100 . . .", the doctor screamed, "Damn it, Boris, don't you dare die on me now! Vali needs you! You've got to stay alive for her!"

Then a terrible crash sent Stone spiraling forward—and the lights went out again.

Some time later the doctor's head stopped spinning. Alone in the still, silent darkness, he wiggled his toes and fingers to see if they moved—and tried to figure out what was pressing on his neck and back.

A flashlight beamed in Stone's direction—showing him he was wedged into the CRV's nose.

Vali called, "Are you all right, doctor?"

Bruised and battered, Stone rolled free of the tight space and stood up shakily. "I'm fine, I have to get to Boris—!"

Then he heard a weak but clear voice—speaking words he'd heard *ad nauseam* from the back of the minivan on so many family trips.

Boris said, "Are we there yet?"

Stone lurched toward the other man—then realized the CRV didn't seem to be moving. "I guess we are."

"Vali, could you hand the good doctor your flashlight? I want him to check why we lost power when our landing skids hit. I mustn't have done a good job wiring the batteries, and one of my cables broke loose."

His wife whispered, "You did a won-

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derful job, my love."

She smiled. "Listen! Do you hear them?"

Still woozy, Stone dimly heard voices and a siren outside the craft. Wobbling forward, he released the CRV's side hatch.

Dry tepid air and the stabbing beam of a searchlight cutting through the ebbing twilight greeted him as the door came free. The first person he recognized sprinting toward the vehicle, white coat flapping, was Mina Osler. Surprisingly spry for a sixty-five-year-old grandmother, she grinned at him and said, "Dr. Livingstone, I presume?"

Ignoring the welcoming brown hand she extended, Stone waved toward the interior of the vehicle. "Boris needs help right away. We had to cannibalize our equipment getting down here, and he's not even hooked up to a defibrillator!"

Mina's face instantly turned as grimly professional as his. She called behind her, "Get that stretcher over here *now!*"

Feeling much too dizzy to help, Stone stepped tentatively outside to the runway to let the paramedics have more room to work inside the craft. He watched them load Boris onto the stretcher and, under Mina's careful scrutiny, hook him back up to a battery of life-support equipment and IVs.

Vali stepped out of the CRV and stood close beside him. Her thin lips formed a grateful smile.

"Thank you," she said, "for everything you did to help Boris. And for being our friend."

A smile flitted across Stone's face before dying stillborn. He shrugged. "You're welcome."

The stretcher clanked against the side of the CRV's hatch as the paramedics carried Boris outside. As they passed, he grinned and waved at Stone. "Thank you, my friend. And remember what we talked about on the way down!"

Vali held her husband's hand as she walked beside the rolling stretcher toward the waiting life-support vehicle. Stone started to stagger after them until Mina's voice stopped him.

"Where do you think *you're* going?"

"I have to ride to the hospital with Boris."

"No, you don't. He's not *your* patient anymore. In fact, ever since you landed, *you've* been *mine!*"

Her chuckle died as she looked more closely at him in the fading dusk. "You don't look so good."

As the world spun dizzyingly around him, Stone slumped to the concrete and stretched out supine on its comforting coolness. "I don't *feel* so good. Better tell the DUCM people they still have some work to do on their readaptation experiment."

Mina's moonlike face—the dusky shade of a penumbral eclipse—bobbed in front of him. "Here's what's wrong!"

She ripped off the long-forgotten VSs from behind his ears, then fiddled with a valve at his waist. "You were supposed to remove these and turn off your negative-pressure trousers when you deorbited! Keeping them on in 1 *g* was making you orthostatic and a neurovestibular mess!"

"Sorry. I got distracted."

As Mina called for another stretcher, Stone saw the nearly full Moon rising brightly above the eastern horizon. As he watched, the silvery orb seemed to recede into the blackening sky and vanish from his grasp. But though he mourned its loss, like Antaeus reborn he felt the Earth's strength flow back into him.

For better or worse, he was home to stay.

Stone lay alone and shivering on his lumpy bed at the hospital—staring up through blackness at the unseen ceiling. The door to his small room was slightly ajar. Only the faintest hint of fluorescent light filtered through from the empty silent corridor outside. On a nightstand, "6:28 A.M." glowed in fiery red.

He'd probably used this room years

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ago when he was on call as a resident here at St. Luke's. But he didn't remember it. And right now, enveloped in a cold black nothingness he hoped would last forever, he didn't want to remember anything.

Minutes later the clock radio came to life. Faint symphonic music from a local FM station assaulted his ears.

Sounds late Romantic. Tchaikovsky?

He sighed. *Doesn't matter. Nothing matters anymore.*

The door creaked halfway open. The dim light from the corridor created the shadowy outline of a chair beside his bed. A tiny window behind the chair showed only darkest night.

A somber figure entered, and sat in the chair. As the music played softly in the background, Vali spoke.

"I can't believe he's dead."

Stiffly, painfully, Stone sat up on the side of the bed, and faced her. "I'm sorry. We're all sorry it happened."

"He was laughing and joking in the ambulance."

"All the doctors who treated him are experts. They did everything it was humanly and medically possible to do before calling the code."

"He was still smiling when they put him in his hospital bed. I was sitting beside him, stroking his cheek when—"

Vali sighed. "After everything we went through—Boris still died."

"We all talked about this late last night, after it happened. Sometimes you do the best you can—and it's still not enough."

"If you'd been here, maybe you could have done something to save him."

Stone shook his head. "Even if I'd argued Mina into letting me come here sooner from the JSC infirmary when we heard Boris was doing worse, it wouldn't have mattered."

They sat silently, oblivious to the tumultuous orchestral score whirling quietly from the radio.

Vali whispered, "What will you do now?"

"Learn to live without doing everything I wanted to do with my life. Devote my *full* time and love to where it should have been all along—with my wife and kids. I've said my farewell to space too."

Her voice turned icy. "That's not what I meant! What will you tell your superiors about what we were doing on the station when Boris had his heart attack?"

Stone hesitated. "The truth. They need to know everything that happened."

"*Why?* Boris asked you not to! All it will do is ruin his reputation, hurt the others' careers—and punish me!"

"I don't *want* anybody to be hurt. But this goes beyond our personal concerns. On Earth, the chance of someone as fit as Boris having an MI during sex is maybe one in a million. And yet—on the station, it *did* happen! Maybe—no, *probably* it was a coincidence, and would've happened even if he hadn't been doing it, or under such stressful conditions for him.

"But I don't *know* that—because there's no good data on how risky sex in space actually is. That's something we *need* to know, to protect all the men and women who'll travel there in the future. Maybe, if what happened to Boris can teach us how to keep *them* safe—maybe his death will have some meaning. I wouldn't be doing my duty as a doctor if I kept back any facts that could be medically relevant—that might prevent someone else from dying!"

Vali's words dripped acid. "Don't preach at me! All *I* know is you're destroying *my* life! *You* still have your family, your career as a doctor. I've sacrificed *everything* else to go into space—and *you're* tearing it away from me!"

Stone shook his head desperately. "I don't *want* that to happen! I realize now how much you've given up—that you need and *deserve* to go back to space more than I do! But I have to do the right thing."

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"And you're sure it's the right thing to do."

A terrible weight pressed on Stone's chest. "No, I'm *not* sure. It's just—as best I can tell—what I *have* to do. Believe me, Vali, I don't *want* to do it!"

Valentina rose from the chair and stood in front of him, her face scarlet and ugly with rage. She hissed, "All you care about is your 'duty'! If you were a *real* man, with any human feelings, you would have made love to me with everyone else. Maybe, if you'd been in Trans-Hab when Boris became sick, you could have begun treating him sooner—and he'd still be alive!"

Her palm swung like a scythe and slapped his cheek viciously. She laughed at the thread of blood trickling from his mouth. "See, you don't even react! You *are* a rock—a stone!"

Vali made a tight fist, drew it back to strike his other cheek—

And tumbled back into the chair like a broken puppet.

"*How dare you hit my husband!*"

Stone looked up to see his wife towering menacingly over Vali—ready to shove her again if she dared to rise.

Vali stared at the other woman's face for a moment before recognizing it. She pointed an accusing finger at Stone. "He killed my husband!"

Donna sat down beside Stone, and wrapped a supportive arm around his waist. Her voice was low and firm. "No, he didn't. I don't know everything that happened on the station. But I know my husband *cares* about other people. He always tries his best to help them, no matter how much it hurts or costs *him*. He's the most loving man I've ever known—and if you don't see that too, you don't understand him at all!"

Vali gazed at the two lovers sitting close together on the bed—and began to weep. Her heartrending sobs faded away as she ran from the room, into the darkness without.

No one noticed the music on the radio end with a whirlwind of crashing cymbals, blaring brass, and thundering timpani. The announcer's words ("That was Tchaikovsky's tone poem, *Francesca da Rimini*. Now we hear Haydn's String Quartet in B-flat Major, op. 76, no. 4.") went unheard.

Donna whispered, "I flew down as soon as they told me what was happening and the airport reopened. The kids wanted to come with me, but I thought it'd be better if they weren't here if . . . something happened to you—".

Stone crumbled into his wife's embrace, desperately warming himself with her love. His cheek, still stinging from the blow he'd taken, pressed soothingly against Donna's. A tear trickled from the corner of his eye, and met one of hers.

"I did the best I could, Donna."

"I know you did, Alex. I know."

As the soulful opening melody of the "Sunrise" quartet shimmered in the room, the first rays of dawn filtered through its tiny window. Their golden glow enfolded two broken hearts beating again as one, caressed by light. ■

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THE HUMAN GENOME RESULTS:

Pointing the Way to Artificial Life

Steven Bratman, MD

Two seemingly independent lines of research may point toward new insights—and new questions—about the nature of life.

When the Human Genome Project announced that *Homo sapiens* barely edges out roundworms in the gene possession department, news services around the world took the fact as a criticism. Surely beings as sophisticated as ourselves should have millions or billions of genes rather than a trifling 30,000! How could such a small number of data points specify a person? After all, even the Windows operating system runs to millions of lines of code.

Wounded pride aside, this relatively small number of active genes is a boon for medicine. There's good reason to hope that over the next twenty years, this relatively small "database" will be thoroughly searched and used to create fundamental cures for numerous diseases.

However, there's another consequence of the surprisingly small genome as well: if 30,000 genes can store all the information necessary to build a person, it should be possible to use digital genes to evolve intelligent digital life, and do so within the limits of today's technology.

Science fiction has traditionally assumed the existence of intelligent machines without looking closely at the process necessary to arrive there. From the "positronic brain" in Asimov's classic robot stories, to AIs downloaded from human to machine, artificial intelligence has simply been brought into being by declaring it so.

Unfortunately, in real life, artificial intelligence has not enjoyed such stunning success. Researchers have found it difficult to even match the accomplishments of simple living organisms. The brain of a solitary wasp can find its nest by visually mapping its environment on a scale ranging from millimeters to miles, but, despite enormous investment, the military can't design a weapon capable of automatically locating a lumbering tank.

Since it has proven so difficult to build intelligent systems from scratch,

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some AI programmers have tried to take a leaf from nature's book, and evolve them instead. As we shall see, evolution offers enormous advantages in terms of information density and problem-solving efficiency. "Genetic programming" techniques attempt to copy certain facets of nature's technique, and have achieved some limited success.

However, nature didn't evolve intelligence alone: it evolved life. The stunning minimalism of the human genome suggests that we might be able to evolve life too. We should be able to achieve this by imitating the SETI project and putting screensavers (in this case, self-replicating ones) on millions of computers. As we shall see, the mathematical forces of natural selection would tend to spontaneously increase the complexity of these creatures, and over time, create true artificial life and artificial intelligence.

In order to evaluate the very real possibilities of such a project, we must first explore the information-finding and compression tool known as natural selection.

Natural Selection as a Search Engine

Natural selection possesses a mathematically enormous capacity to find solutions to problems. In *How the Mind Works* (W.W. Norton & Company, 1999), psychologist and neuroscientist Stephen Pinker describes visiting an exhibition on the biology of spiders. While he was admiring the sophistication of spider's spinnerets and the nanometer precision of their joints, he heard someone say, "How could anyone see this and not believe in God?" Pinker turned in surprise, because at the very same moment he'd been thinking, "How could anyone see this and not believe in natural selection!"

In fact, the mechanism of natural selection is not intuitively obvious, and even scientists of great genius have been known to misunderstand it. The astronomer and mathematician Sir Fred Hoyle, for example, was quoted in *Nature* magazine, November 12, 1981, as saying "The chance that higher life forms might have emerged in this way (evolution) is comparable with the chance that a tornado sweeping through a junk-yard might assemble a Boeing 747 from the materials therein." This erroneous conclusion seems inevitable if one simply calculates the number of possible permutations of 30,000 genes; the age of the Universe would not remotely suffice to assemble *Homo sapiens* by chance.

However, natural selection does not assemble genes by chance. Rather, it uses a powerful search strategy that drastically reduces the time necessary to solve genetic problems. To understand how this strategy works, lets play an extreme version of the game "pick a number from one to a hundred."

In this game, our opponent, let's say a HAL 9000 computer, has picked a number between zero and 100 billion billion (10^{20}). The goal of the game is simple: guess the number.

If we simply propose numbers at random (like evolution, in Hoyle's interpretation), the age of the Universe would be markedly insufficient to hit upon the solution. However, if we instead adopt a method that shares a fraction of the information-finding powers of natural selection, we'll find the answer in ten minutes or so.

Here's the strategy: Instead of making one guess at a time, we make 10 guesses, and spread them out equally over the range of possible answers. Our first round of guesses, for example, would be 10 billion billion, 20 billion billion, 30 billion billion, etc., up to the 100 billion billion upper limit.

Next, we ask the computer to tell us which two guesses are closest to the secret number. The answer to this question will allow us to narrow the range of possibilities by a factor of ten.

For example, if 20 billion billion and

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30 billion billion are the two closest guesses, the number must lie between them. This is only a range of 10 billion billion (10^{19}), ten times smaller than the original gap.

Now, we repeat the same method within the new range of possibilities. At the end of the second round, the interval will have been reduced to 1 billion billion (10^{18}). Only 18 more rounds after that, we'll have the answer!

The same technique could be used to come up with the whole text of Hamlet, or, more to the point, the sequence of proteins in the Human Genome. Its power, like that of natural selection, stems from the exponential nature of repeated (iterated) searches. A hundred billion billion is a huge number, but as a power of 10, it's not very big at all.

This game is analogous to natural selection. The 10 guesses represent "offspring." Each round of guessing translates as a "generation." The rating of closest guesses resembles "fitness."

To see how the guessing game works in real life, consider the natural history of bats.

Bats use ultrasound to "see" in the dark, and depend on high-fidelity reception to avoid banging into trees. The bat skull is highly optimized in shape and size to receive ultrasound bounces—so highly optimized, in fact, that some anti-evolutionists use it as evidence for the guiding hand of a Creator. However, they are making the same error as Hoyle.

It's true that the chance of a single mutation properly adjusting bat heads to perfection is unspeakably tiny. The age of the Universe wouldn't have been long enough for bats to arrive at the solution that way. However, a close look shows that mutations actually function much like the sequential "which of my guesses is closest?" technique described above. Such an iterated search allows bats to properly adjust their heads in far shorter time.

Begin with a population of bats whose skulls are not quite perfect for ultrasound reception. Assume that each bat has ten offspring over its lifetime (they actually have more). Due to random genetic variation, some of these bat babies will have slightly more efficient skull ultrasound collectors than others. Those with the better designed skulls (the best "guesses") will have an edge over other bats. They'll smash into fewer trees and catch more fleeing mice. This advantage will make some bats more likely to survive and produce offspring of their own (go on to the next round).

Each of those offspring will then have ten offspring, and so on. Just as in the guessing game, this technique of repeated searches will hunt through the range of potential head shapes and home in on the ideal in a radically short time—a matter, perhaps, of only a few hundred generations.

Thus, the apparently long odds of evolution turn out to be shorter than they seemed. The odds shrink even further when you consider that natural selection holds a huge advantage over the guessing game. The game has only one contestant, while at each generation there are millions of bats making their "guesses." This is the mathematical equivalent of having everyone in Los Angeles play the guessing game cooperatively. Such numbers add enormous efficiency to the search process, and are an essential feature of evolution's capacity to solve problems.

With its huge numbers of "contestants" and the exponential power of iterative searches, natural selection has proven capable of solving practically every challenge the world can throw at it. No wonder there are living organisms in boiling volcanic vents, in the Kalahari desert, in the Antarctic, and, at present, in a metal can orbiting the earth: natural selection has sifted the genetic possibilities and found the optimum coping strategy.

* * *

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Natural Selection as an Information Storage Device

The process of solving life's problems leads to the development of immense amounts of biological information. Not only can natural selection acquire data, it can also store it with extreme compression. The extent of the data stored with the help of our DNA is far larger than it may at first appear, and gives additional support to the notion that if we wish to create artificial life, we might need to use an evolutionary process to do so. Any other method would necessarily create far less sophisticated (information-dense) "creatures."

It often goes unrecognized that DNA represents only a portion of the stored information necessary to construct an organism—the digital portion. The rest of the data is contained in an analog structure made of proteins and other organic chemicals. This analog structure is named an ovum.

An ovum is an intensely organized bit of biochemical matter, containing both protein and nonprotein molecules carefully arrayed in three-dimensional space, and held there by microtubules and microfilaments. These seed chemicals prepositioned for use largely control the unfolding process of embryological development. Without this context in which to place a chunk of DNA, gene sequences cannot be used to create a living being.

There is probably more information encoded in the structure of the ovum than in DNA. This is information so three-dimensionally dense that it would be difficult to imagine building it from scratch. However, it is not built from scratch: any particular ovum is simply the momentary aspect of a cyclic process going back to the dawn of life.

The ovum from which a person is born was constructed in his mother's ovary. However, her ovary was only able to carry out this process because of preplaced chemicals in the ova she herself grew from. That preplacement in turn depended on seed chemicals one more generation back, and so on.

DNA and the structures necessary to decode it go back hand in hand, codeveloping in mutual interdependence from the earliest stages of life.

When humans set about building something, we don't do it this way. We create a linear blueprint and follow its instructions in order. But evolution creates cyclic, iterative modes of operation, building up information over evolutionary time, packing it in at each round with extraordinary efficiency.

Perhaps we should copy evolution's technique.

From DNA to Artificial Life

Since there are only 30,000 digital units (genes) in a human being, it seems well within the power of today's computers to manage an artificial evolutionary process.

Techniques based on elements of evolution are already used by AI programmers. As described by Robert Matthews in *New Scientist* ("The Ideas Machine" *New Scientist* 01/20/01, Vol. 169, No. 2274), so-called "genetic algorithms" are already available commercially to arrange airline hubs and design electronic circuits. Advanced techniques called "genetic programming" developed by John Koza of Stanford University are beginning to tackle even more complex problems.

Genetic programming allows computer programs to "mutate," trying different combinations of specified subroutines and equations. Like life itself, programs "grown" in this way develop solutions that are oddly nonlinear.

Despite these successes, current genetic programming techniques lack much of the information-finding capacity of actual evolution, for one reason: the "population" at each "generation" is too small. Genetic programming is done within conventional computers or small networks, and involves relatively small numbers of programs ("organisms").

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Natural selection, as we've seen, uses large populations to achieve its searching power. Bats would have taken far longer to optimize their skulls if there had been only ten bats in the world.

The Internet offers a way to greatly increase the power of genetic programming. There are hundreds of millions of computers tied together over the World Wide Web. If these could be harnessed as hosts for self-replicating programs, the population size should be large enough to get something very lifelike started.

Here's one recipe for cyber-life: Begin with a program that can make nearly accurate but not entirely accurate copies of itself, using a data table as the equivalent of DNA. Give these self-replicating programs rudimentary abilities to email themselves to other computers. Attach these programs to screensavers, and convince millions of computer users to run it on their machines. (This last step is the most unlikely part of the scheme, but read on for a possible work-around.) Wait a few years. At the end, the Internet should teem with artificial life.

The development of cyber-life should follow roughly the same path as biological evolution. According to current theories, DNA-based life began as self-replicating bits of RNA in the oceans of Earth or (or perhaps in extraterrestrial seas). By the laws of exponential growth, the oceans were soon filled to capacity with these substances. A growing shortage of space soon led to "competition" between self-replicating units.

Over time, RNA units that were more "fit" than others tended to predominate. Perhaps they broke down less easily in the sunlight, or more tightly bound the stray molecules necessary for replication, but in any case, they had a "survival" advantage. This "battle" for "survival" caused the formation of self-replicating chemicals of increasing complexity. Eventually, this complexity attained the stage we call single-celled organisms.

A cell contains fantastic amounts of compressed information. From an amoeba to a human being is far less a jump than from bits of RNA to an amoeba. Once there are cells, intelligent life is probably not far behind.

However, there is nothing unique about biological replication. According to mathematical analysis by Stuart Kauffman in *The Origins of Order: Self-Organization and Selection in Evolution* (Oxford University Press, 1993), steady progression from simplicity to complexity is a fundamental mathematical property of any self-replicating system. Much the same course of events should occur with any self-replicator, whether it's a bit of RNA, a cultural "meme," or a computer program. With only a relatively small "genetic core," our evolving programs should spin out a web of efficiently packed information analogous to ova, endowing themselves with capabilities out of proportion to their size.

As our self-replicating screensaver programs continued to "reproduce," computer resources would eventually become tight. Programs slightly more "fit" at drawing CPU attention toward themselves would have an advantage. This "competition" between programs should create a battle for "survival," leading toward the development of programs of increasing sophistication.

Let's call these hypothetical cyber-creatures *bitacules*, out of analogy to Leeuwenhoek's animalcules—dimly seen bacteria in his primitive microscope. Natural selection would lead to the development of bitacules good at terminating the operation of other bitacules, whether in their own computer or across the Internet in other computers. Ability to "kill" and "escape being killed" would thus be optimized, as it has been in DNA-based life. Excelling at murder requires a range of skills, and intelligence is one of the most important. Thus, over time, bitacules would grow increasingly intelligent.

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Besides having each other to deal with, bitacules would coexist in a world of humans. Human preferences would be another source of selection pressure. Bitacules that deployed particularly appealing screensavers, for example, might have enough entertainment value to extract CPU time. This might lead bitacules to develop "artistic skills." Conversely, bitacules that damaged a host computer, by wiping out data, for example, would invite the ire of a human owner and be destroyed. Thus, bitacules would evolve to be good neighbors.

They would also evolve emotions.

The Feelings of Cyber-Creatures

In many stories, AIs are emotionless beings, solving problems in a cold-blooded, hyperlogical manner. However, if artificial life were created using evolution and natural selection, emotions should develop as naturally as any other adaptive skill. The explanation lies in the field of evolutionary psychology.

Recognizable emotions exist in all complex animals on earth. Anyone who has seen a dog afraid, a ferret enraged, a bear at play, or a mare in love with her colt, knows that mammals, at least, demonstrate emotions very similar to our own. This is not surprising, given that all mammals share major brain structures (such as the limbic system) responsible for creating emotions.

But octopi also show recognizable emotions, and an octopus is the closest thing on Earth to an intelligent alien. (Other animals, such as whales and primates, are more intelligent, but they are much less alien.)

Octopi are invertebrates; their common ancestor with human beings was some kind of worm. While the octopus brain is sophisticated, producing behavior possibly as advanced as that of a dog, it shares few features in common with a human brain. A dog's brain (or a whale's, or chimpanzee's) is made much like ours, with a limbic system for emotion and frontal lobes for thought. An octopus has no such structures. Nonetheless, those who observe octopi find evidence of anger, fear, and, possibly, affection.

The reason for these commonalities appears to lie once more in the forces of evolution and natural selection. In *How the Mind Works*, Stephen Pinker makes a compelling case that emotions such as anger evolve because of their utility in interactions. Like bat skulls and spider spinnerets, they are simply useful adaptations to the challenges of survival.

Pinker's complex and often hilarious discussion of the origin of anger embraces nuclear weapons strategy, negotiation on the car sales lot, and the teenage game of chicken. The central feature of his argument consists of the point that anger offers a great tactical advantage in certain common social situations.

Normally, when animals size each other up, they make a rather accurate appraisal of which is stronger. Instead of actually starting a fight, the weaker one will ultimately retreat from confrontation. This "rational" behavior is energy efficient. It forestalls useless mutual damage.

However, an enraged animal (or human) does not follow the usual rules. Instead of making a rational calculation, a hothead simply explodes. The very fact of this nonrationality gives the infuriated one significantly enhanced bargaining power under certain conditions.

For example, consider a bear facing a solitary wolf. Bears are far more massive than wolves, and in a fight, the wolf is guaranteed to lose. Given this inevitability, most wolves will simply back down when facing a bear, perhaps after a tossing off a few desultory lunges and growls.

Suppose, however, a particular wolf has offspring to defend. It may be a mother wolf, or an adolescent assigned the task of guarding pups. In either case, this wolf will not behave "rationally." It

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might attack as if it expects to win; or, more precisely, as if it doesn't care whether it lives or dies. As soon as the bear detects this "irrational" behavior, the balance of power shifts. A rational bear might not find it worthwhile to risk getting a painful bite from an irrational wolf even though the ultimate outcome is clear.

Irrational anger is thus ultimately rational; it's a successful method for a weaker individual to win out against a stronger one, or for a strong individual to face down a crowd. No one wants to face an out-of-control maniac unless it's absolutely necessary.

Every other emotion is similarly practical. Desire forces a concentration of the mind on the object necessary to survival, such as food, water or sex. Parental love ensures that a mother will support the survival of her genes by attending to her children. A similar analysis shows that sexual competition, friendliness, playfulness, bluffing, and every other feeling-based action has a well-defined function.

Because emotional behaviors are useful adaptations, there is every reason to believe that cyber-organisms would behave just as emotionally and passionately as any DNA-based life-form.

But would bitacules *feel* any of the emotions they exhibit? Would they be sentient?

Consciousness

It is a well-established tradition in science fiction stories that when a computer achieves a certain complexity, it suddenly becomes conscious. However, a close look at the nature of consciousness suggests that if it were to develop in a machine, we'd never be able to tell the difference.

The only consciousness we can appreciate from direct experience is our own. I know that I have an *inside* because when someone drops a piano on my foot, I don't simply find myself reporting damaged sectors in the region of my toes. I feel *pain*. My foot *hurts*. Similarly, when I have a desire, I experience it vividly. I know quite clearly that I'm sentient.

However, I can't know directly that anyone besides myself is conscious. This is a homely truism in the philosophy of the mind, the branch of philosophy most directly focused on this issue. If the world were populated by clever but unsentient automatons, we'd be none the wiser.

Philosopher Georges Rey claims that that since a bicycle accident he suffered at the age of 15, he's stopped being sentient. He states that he's a zombie, an automaton with no inner life, a mere fabricator of emotional behavior. As Stephen Pinker says when he tells the story, one presumes that Rey is kidding. However, the fact that there's no way to prove it makes his point: consciousness is essentially nonobservable.

Nonetheless, we are morally certain that other human beings are conscious. Most of us believe that animals have interior experiences too. Detailed analysis, however, shows that the origin of this certainty and the basis with which we apply it remains highly elusive.

Consider the toy called a Furby. These little gray gremlins loudly beg for attention when left alone, and only when someone stops by and stimulates their under-the-fur sensors with a tickle or a pet will they shut up and "go to sleep."

The emotional pull of a Furby is undeniable. Few can walk by one and ignore its "complaints." However, even fewer would claim that a Furby actually *feels* any of the emotions it displays. A Furby is simply a machine designed to *behave* in ways that manipulate the feelings of humans, especially human children.

The situation is much the same with the robot Kismet, a kind of super-Furby built at the Massachusetts Institute of Technology. Kismet has a wide range of highly convincing "emotions" that involve situation-appropriate facial expressions and movements. The impulse to

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credit Kismet with genuine feelings is said to be almost irresistible.

If a person were transplanted from the Middle Ages, he would most likely take Kismet for a conscious (and probably diabolical) creature. The only reason we do not fall under the same spell is that we're technologically sophisticated. We understand that relatively simple mechanics underlie Kismet's apparent emotions.

However, examination of the basis for this dismissive certainty leads to some confusing conclusions. Do we require lack of understanding of how a device or living thing works in order to credit it with consciousness? Or is there a fundamental rule that a simple creature can't be conscious? In either case, where do we draw the line?

I remember watching through a microscope as an amoeba recoiled from a hot needle, and thinking "oh, the poor thing." Further into the medical school lab, I learned that heat sensitive microtubules were responsible for the reaction. This insight reassured me that the amoeba was not really feeling pain: it was simply responding mechanically.

One could suggest (as did some students in the class) that a nervous system is necessary for an animal to experience pain. However, when a worm pulls back from a drop of acid, the nerve transmissions that trigger muscle contractions are not particularly more complex than the electrical connections in a Furby.

Another approach proposes intelligence as a criterion for consciousness, but this too falls apart on examination. A mouse is not particularly bright compared to a person, and yet anyone who has watched a mouse quiver in terror at a stalking cat knows that the mouse feels something very deeply at the moment. Is the intensity of that inward experience of fear diminished proportionally to the mouse's brain capacity? Probably not. Ability to reflect on experience requires intelligence, but if a velociraptor were stalking me, I'm not sure that my visceral terror would differ very much in quality or quantity from the experience of that mouse. In pure inwardness, I suspect that a mouse is much my match.

In the Victorian era, it was fashionable to believe that animals were automatons, incapable of feeling anything. Today, even our laws reflect a different view. There wouldn't be a law against cruelty to a Furby or a super-Furby because we don't believe they're sentient; conversely, cruelty to animals is illegal precisely because we believe they have inner feelings. But *why* do we believe this?

Quite possibly, we sympathize with mice simply because they are similar enough to invoke emotional resonances-resonance in us. In other words, it is their Kismet-like qualities that make us regard animals as sentient. This is a rather illegitimate route to such certainty, but it has proved impossible to find any better argument.

Like mice, bitacules would exhibit emotional behaviors. These would be intrinsically more genuine than that of Kismet or a Furby, because they would serve a purpose beyond manipulating human feelings. But would bitacules feel the feelings they expressed?

We'd never know.

Will it Ever Happen?

As I mentioned earlier, there is a severe practical problem with the bitacule scenario I've presented: few people would willingly accept self-replicating programs on their computers. Computers already crash far too often. If there were bitacules breeding in them, the crash rate would undoubtedly go up, at least at first.

One option might be to *pay* people to take such programs. It would be expensive, but research always costs money.

The other option is a devious one: use a benign computer virus.

A computer virus that caused no harm and, moreover, showed no sign

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that it existed, might successfully spread throughout the Internet. Variants that did cause problems would be eliminated. But the harmless ones would go on to evolve, and might someday become intelligent.

In fact, such a process might already have begun. My computer sometimes seems awfully busy in the middle of the night . . .

About the Author:

Steven Bratman, MD, received a mathematics degree from UCLA and an MD degree from UC Davis. He is the medical director of TNP.COM, a website devoted to science-based evaluation of alternative medicine, and the author of nine nonfiction books in the same field. Recently, he published his first science-fiction story in the magazine *Exquisite Corpse.* ■

IN TIMES TO COME

A few years back, Amy Bechtel made an impressive debut here, winning the AnLab award for "Best Short Story" with both of her first two stories. She hasn't sent us as many stories as many of us might wish since then, but they're always worth waiting for. She's overdue for a cover, and next month she gets it: a Kelly Freas opus for "Sea Changes," the latest in her popular "Little Monsters" series. Our April issue will also offer stories by Jerry Oltion, Charles L. Harness, and Charles Sheffield, plus the conclusion of Robert J. Sawyer's *Hominids*.

Robert Zubrin has also made a big impression here with his science fact articles, and next month we have his first new one in a while. It may take you a while to see why it's called "Galactic Society," but there is a good reason. Before you can speculate about the nature of galactic society, there's a lot of groundwork to be laid; some of it will likely look familiar, but Zubrin (as usual) points out some important angles that others have overlooked.

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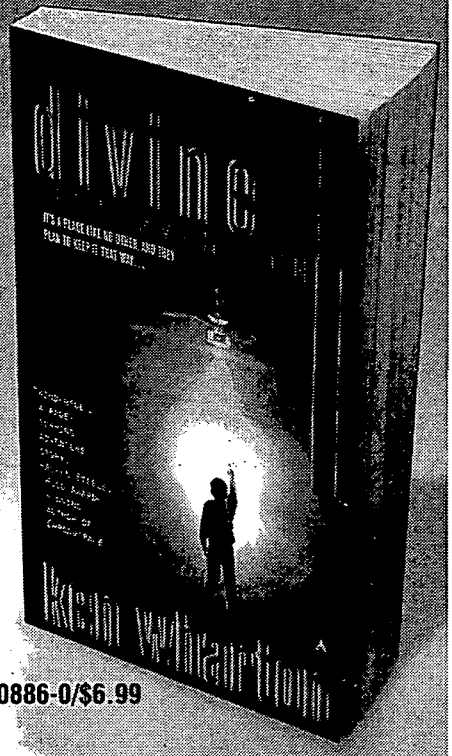

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PARCHMENT IN GLASS

Ron Collins

It can be hard to distinguish between medium and message—or even messenger.

Radio waves rose from the surface of a planet in the Alpha Centauri system, cutting through an atmosphere of oxygen and acid to break into the vacuum of space. Four years later the signals reached Martian highlands and fell upon a collection of listening dishes at Kochi Observatory.

At local noon, a program packaged the data and sent it on tight-beam laser to a satellite in near-earth orbit.

"I'm too old for this," Torrance thought as he checked his sideburns' trim. Lines and dry patches marred pebbled skin. His crew cut was graying to white. Extending a man's telomeres may double his life, but signs of age remained as obvious as rings on a tree stump.

Even his eyes were worn and faded.

It was just past five in the morning. Torrance was in the Kedra Hotel, a high rise that overlooked the western shore of the Potomac River in Crystal City, Virginia. Willim Pinot—the United Governments intelligence officer—expected him at 0700. He still hadn't had breakfast.

He sighed and ran a brush over his scalp.

The UGIO had been vague about the agenda, and no matter how often Torrance played the game, politics always left him uneasy.

He stepped back and yanked his blue dress jacket to the side. His buttons were aligned, his shoulders square. He was seventy-one—no longer the slender kid from *Everguard*—but he still presented the uniform with a bit of dignity. If he ever *did* decide to do something rash like retire, he would miss the uniform as much as anything else. He strapped his personal comm system over his forearm, punched up his temperature and blood sugar, and glanced at the time.

That was when he first noticed the red icon flashing.

The process ran every night.

It started at a Very Large Array spread over the three hundred square kilometers of Martian surface that comprised Kochi Observatory. Each day, Kochi compressed data and transmitted it to a receiver in Earth orbit, which then split the signal and forwarded it to several

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destinations—one being a computer in an office just north of Milwaukee, Wisconsin. There, Torrance's program stored Kochi's data in overlapping fifteen-minute segments and compared these fresh radio emissions to stored files of noise *Everguard* had recorded during its last mission.

To Torrance, the *Everguard* files were important. They were hand-inked parchment in green bottles floating on the currents of the most massive sea known to man, words sent from unknown people who lived on Alpha Centauri A's second planet. No one else shared his opinion, of course. Eden—his compatriots pointed out—was a poisonous place where life could not exist, a fact proven by every remote study ever undertaken.

He was, of course, shackled by his reluctance to release the *Everguard* noise data. If it became known that the mission had launched wormhole pods despite the possibility that life might exist on the planet, the entire command structure would be exposed to executive review. Torrance was loyal. His commanders were good people. They made a decision that opened the galaxy to the human race. He might, in fact, have made the same decision if he were in their shoes.

Still . . .

Too much of his life was tied up in these files. He had commanded shipboard systems and weaponry aboard *Orion*, served as the mission officer for Ceta, the first colony in the Cassiopeia Eta system, and advised the five Delta Pavonis colonies. Yet, he always returned to the files. They consumed his soul. Letting the issue of life on Eden drop within the scientific community did not mean Torrance had to give up. So he gathered data from Kochi, and he wrote a program—a simple routine, really, a correlation algorithm that looked for similarities between the *Everguard* files and Kochi's radio signals.

Now the icon was flashing on his personal comm system.

* * *

Bypassing breakfast, Torrance accessed his home unit. The screen changed to a familiar interface panel. He pulled reports and examined Kochi extracts. Data filled the screen. Automatic sorting routines charted key graphs. The passage of time faded to a blur. An hour later, Torrance sat on the edge of his bed, deliriously dizzy.

The correlation was solid—full-spectrum frequency matches in nearly every frame.

The world was suddenly small but expansive, understood but unfathomable. It would take weeks of hard work to make the data presentable, but Torrance understood a truth massive like a block of granite—a truth that had eluded human beings since time itself.

Life existed outside the solar system.

His heart burst. He wanted to cry, wanted to hug someone, wanted to run into the streets and shake people by the shoulders or kiss them on the cheeks or just hold them tightly and howl at the sky like the crazy old men on Arazorn.

He wanted . . . well. Mostly he just wanted to *tell* someone.

But the room was empty and quiet.

The heating system kicked on. The bed sat unmade, sheets wadded and rumpled at the foot. He rubbed his eyes and closed his system. His lips were dry and parched. He glanced at his watch. Forty-five minutes to get to Pinot's office.

He picked up his hat from the dresser and checked the mirror. Crisp. He smiled and gave himself a salute.

Politics be damned, there wasn't a thing in the world Willim Pinot could tell him today that would get him down.

He took the underground walkway to the monorail transfer and got off at Arlington. The bioscanner allowed him to take the purple line from there. This was Wilson Cross—a shelter dug deep under the eastern foothills of the Appalachian Mountains, a place where

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every door warranted a security code and every wall was made of reinforced concrete lined with radiation-hardened composites. His lighthearted mood gave the process of navigating checkpoints a feeling more like playing secret agent than its usual baggage of paranoid scrutiny.

Everything seemed so real—the smell of his escort's boot polish, the echoes of footsteps in the underground hallway, the dryness of cool air, the escort's name spelled in clean white letters on a black badge: Davies. The corridors were tight and brightly lit, the walls painted standard-issue beige. Image projectors at regular intervals gave the area a professional flare. Even the metallic clangs of tri-level stainless-steel security doors could not dampen his spirits.

They came to a doorway. A crimson laser flashed his optic nerve. The door slid open.

"Good morning, sir," Torrance said as he stepped forward.

The door closed.

"Good morning, Captain," Pinot answered in a graveled voice, motioning to a padded blue chair without looking up from his desktop screen. "Have a seat."

Willim Pinot was arguably the most powerful man in the solar system. He had Asia somewhere in the distant recesses of his ancestry. Black eyes sat hard and firm above rounded cheekbones like a pair of polished marbles, his nose upturned and flattened. A scraggly, gray-laced goatee grew in a sprawl around his lips. His shirt was white and open one button at the collar. It was early, yet already rings of sweat darkened the area under his armpits.

Torrance sat while Pinot marked something on his screen.

Pinot's dress coat hung from a rack in the far corner. Paperwork cluttered his desktop. The leather chair squealed as the UGIO put his stylus down, sat forward, and clasped his hands together.

"Can Tailor get you coffee?"

"That would be good, thank you."

Pinot spoke to the computer. "Coffee, please. Sugar." He paused and looked at Torrance. "Cream?"

Torrance shook his head.

"No cream."

Pinot smiled. "I suppose you wonder why you are here."

"The question has crossed my mind."

"I need you to kill a man."

"Sir?"

"You heard me."

"But . . ." Torrance squirmed in his chair. "I'm not an assassin."

"Correct." Pinot nodded matter-of-factly. "You are a scientist—an engineer, actually, but close enough for government work, eh?"

Torrance frowned.

"I am in the unique spot, you see, of needing someone who is both a scientist *and* an assassin. Since there is no time to train an assassin to be a scientist, I think it wiser to go the opposite direction. Don't you agree?"

"I . . . guess so," Torrance heard himself say.

The door opened and Tailor, Pinot's administrative assistant, entered with a coffee service.

An edgy Colombian aroma filled the room. The sound of liquid flowing over china was ritualistic in the silence. Pinot motioned Tailor to ignore his teacup in lieu of the double-sized mug on his desk.

Tailor left. The door closed.

Torrance lifted a cup and cradled it in his palm. The china was thin—the coffee warmed it quickly. He sipped, blowing briefly to avoid scalding. He wished he had eaten something.

"The World Council on Wormhole Physics is being held next week," Pinot said simply. "You will attend, and you will kill Emil Pentabill."

"If I refuse?"

Pinot gulped his coffee, then set his mug amid loose paper on his desk. "Neither of your ex-wives will care one way or the other, I'm sure—God knows I can vouch for the disinterest of ex-wives. I know you're not really close to your

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daughters, but surely they need their old man around, don't you think?"

Torrance squeezed his lips into a tight line. He loved Cassie and Mercy. But something had always gotten in the way while they were growing up—a conference to attend, or a seminar to facilitate. There was a war on, after all.

Men were dying.

There had never been enough time. He lost Marisa, his second wife, just as he had lost Adrienne before her. And he was gone while his daughters went from crawling to kindergarten to high school.

He had never felt like a very successful family man.

Pinot's threat, however, was clear and direct. Kill or be killed.

"Why Pentabill?"

"The man is a confirmed traitor."

"I've known Oscar for years," Torrance said, calling Pentabill by his preferred name. "I find that very hard to believe."

"Yet still true."

Torrance shook his head.

"You want evidence?" Pinot pointed to a brown data cube on the corner of his desk.

Torrance picked it up. The cube was small, its edges sharp and prickly.

"Read it at your leisure."

"What's on it?"

"Proof that Universe Three got to him years ago—before, even, your cruise with *Everguard*. Standard espionage stuff. Find a source, start early and small until they're hooked, then raise the ante. By the end, Pentabill sold them the star drive, several exotic matter-manufacturing techniques—specifically including solutions to throat tensors, I might add—and, of course, Kransky-Watt."

Torrance grimaced outwardly.

Kransky and Watt were the first to demonstrate that the kinetic flow of a star's energy could be fed back into a wormhole's gate fields, thereby providing traversable stability. The throat tensors were needed to understand and build the most critical juncture in the wormhole system. It was this technology that had allowed them to draw energy from the interior of Alpha Centauri A to power star drive engines, and hence open up the galaxy to faster-than-light travel.

Universe Three was a terrorist organization—led by Casmir Francis, a flashy man now in his mid-fifties with a bold countenance and a slick delivery. The media portrayed him as ruthless, direct, and intelligent. People were drawn to his charisma, his passion, and the sound bite that had become the mantra of the entire U3 movement: *"We will die only for those things we believe in. And we believe in the Universe."*

Without the information Pentabill had sold, Universe Three could not have developed their own wormholes. Without those wormholes, Francis could not have sustained a galaxy-faring fleet. And without a galaxy-faring fleet, he could not have waged the war that had killed so many young men and women over the past three standard decades.

"Oscar is a very bright man," Torrance said.

"All the more reason to make an example of him."

"And you think I can attend the council without arousing suspicion in advance of the strike."

"A good assassin blends in."

"You're overestimating my status considerably."

Pinot gave a sarcastic huff. "You are no longer one of the scientific elite, Captain. I know this." He raised a pointed index finger. "But this is an advantage for you. Your compatriots will accept your attendance, but will keep you at arm's length. It should be quite easy for you to fade into the woodwork at an appropriate time."

Pinot's straightforward dissection of his standing stung.

He had gained celebrity within the scientific community as officer of record in setting the first wormhole. But when his passion for the idea of life on Eden

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was unearthed, he found himself shunned cleanly and coldly. Nothing, it seems, ostracizes a man so fully as thinking outside the accepted.

"So I'm a Trojan horse?" Torrance said. "A wolf in sheep's clothing?"

"Trojan horse," Pinot said as he rubbed his goatee. A smile creased his cheeks with a series of abstract folds that made him look like a washed-out coconut. "That is good."

Torrance drank coffee and put the cup back on the tray. The liquid ate the lining of his stomach. The concept of killing in cold blood was suddenly very real. The coffee did not help his dry throat.

"I can't do it," he said. The pleading quality in his voice made him feel weak and somehow ashamed.

"Men are always capable of more than they think."

"It's not like that," Torrance lied too quickly. "I'm *not* afraid of it. I have a new project I need to look into."

"Really? I reviewed your assignments with Admiral Cash yesterday. She made no mention of new projects."

"It's . . ." Torrance looked at Pinot. The UGIO was enjoying himself. He was a fisherman who had set his hook, playing the game, letting Torrance run but keeping the line taut.

"Admiral Cash doesn't know about it," Torrance finally said.

"Then it cannot be important."

"Only discovery of a new life-form."

Pinot sat back in his chair. "We're not going through this again, are we?"

"I've confirmed cohesive signals from Eden. No mistaking them."

"Don't waste my time, Captain."

Torrance clenched his jaw.

The words *you can't make me do it* nearly came off his tongue. But that was wrong. Willim Pinot's entire career was about making people do things they wouldn't normally do.

Their meeting was done. The parameters of his choice lay before him. Torrance looked across the table and saw confidence and certainty unyielding like an undertow.

Kill or be killed.

As he prepared for bed later that night, Torrance tried to convince himself that his decision to take the assignment hinged on the belief that he had more to do in life, that it was the only way to save Eden. But Torrance had never been very good at shielding himself from what he truly thought.

In the end, it all boiled down to the simple fact that he was afraid to die.

A week after meeting with the UGIO, Torrance found himself on Florecer, the innermost planet of the Cygni B system—a tiny type-K star some twelve light years from the solar system. He sat in the convention center conference auditorium, glancing nervously across the way at Oscar Pentabill. The chairs were large and cushioned, arranged in elevated circles around a central podium. The configuration made the conference feel more like a political debate than a scientific gathering—a fact that brought him a sardonic smile as he sipped chilled water and listened to scientists from around the galaxy argue.

"Alpha Centauri A is going to run out of energy, and we've got to find a way to keep the spacecraft attached to it flying."

"It was supposed to last ten thousand years."

"That assumed the star fueled only a single spacecraft."

"So we're supposed to trust the government this time, too?"

"Don't be an extremist, Vlad. The original estimate also assumed 70 percent flow conversion. Reality is closer to 25."

"That's because Kransky-Watt is so horribly wasteful."

"The truth is their fault?"

"Would you suggest the missions not be flown, and the war lost?"

"There's the problem, then, isn't it?" Selene Runn said.

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Heads nodded.

Torrance sat quietly, watching. Nothing positive was coming from the discussion but, ironically, he felt the bittersweet tingle of healing. He did not want to feel better right now. His assignment was cowardly and vile. It sat in his gut like cold oatmeal. It would change him forever. But he felt something important as he watched this bickering. This was only a stage, a place where names came to rub elbows with other names. Hermann, Yang, Jacob—pick a name, they were here.

But no truth was being discovered at this conference. No science was being performed. Science was done in labs and behind consoles. Science, at its core, was an endeavor one undertook in isolated groups, developing results to bring back to the entire community for review. It was the way of the world—the way of history. Bring hard data and you change the world. Bring ideas and you create spaghetti.

Now Torrance had data.

Late at night, between the seemingly never-ending briefings and training programs UGI agents had been stuffing into his head, he had been working to package information about the most recent Eden emissions into a presentable paper. The effort left him tired and drained. His stamina dropped off earlier in the evenings than it once did, and he had not progressed as far as he wanted. But it was good work, and he was proud of it.

Most current estimates said that Alpha Centauri A would remain viable for something short of four hundred years.

It was all enough to make him sick.

But at least he was doing something about it. He was no longer certain he could say that about this collection of people he once thought of as friends.

"No." A wavering voice came amplified through a personal PA. "That is not the problem at all."

The room shuffled nervously as Fredric Parson stood on rickety knees, gripping a brown cane. His back was bent like a hook. His pate was bald and mottled.

Dr. Parson was 148 years old and living on his last telomere extension. He had been a leading figure in the development of the earliest wormhole models, and it was well known that Kransky wouldn't have gotten as far as he had if Parson hadn't solved the initial riddle that led to the confirmation of material with negative mass. In this way, Fredric Parson was, perhaps, the father of the wormhole.

"We are missing the forest for the trees, my friends. The problem has little to do with spacecraft. The problem here is that as we drain away fusing material, we leave the trash behind. It's only a matter of time before energy released by the star's fusion engine will be unable to resist the star's gravity. When that happens, Alpha Centauri A will collapse under its own weight."

"Then we get a supernova," Kalista McKenna interjected.

Scientists across the room rolled their eyes to the ceiling as McKenna stood up. The young woman from Colorado University was brilliant, but she didn't know when it was best to be quiet. The membership had given her leeway for two years, but their patience was drawing to an end. Now McKenna stood like a corporate martyr in her white business dress with a scarf of pink and purple showing tastefully from her collar.

"That's a fanciful notion, Kalista," Parson replied. "Centauri A, however, is similar to our own Sun. It will not go supernova."

"A star reacts differently when its mass is in flux."

"All theoretical."

"As is everything we do in this field—theoretical science backed up by computer simulations. I have a new solution that indicates pressure waves caused by transient masses act as pseudomass. At the rate we're tapping Alpha Centauri A, its effective mass will rise dramatically.

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Alpha Cen *will* go supernova. The only question that remains unsolved is whether we'll get a black hole or a neutron star in its place."

The sound of clearing throats reverberated.

Chairs rocked backward.

Torrance nearly snickered aloud at the level of discomfort around the room. Admittedly, McKenna's idea was brash and most likely wrong. But it was also new and unexpected. Torrance could not help but delight in the ripples the mere suggestion caused this gathering of scientific minds. For the first time, Torrance was actually glad he had come to the council.

Parson's reed thin voice echoed throughout the center. "All we can really say is that never before have we had an opportunity to learn about this type of an event. We need to prepare. We need to push for new programs and more funding."

"Hear, hear."

A smattering of low-voiced conversations ensued. Torrance thought they were preparing to move to the next item on the agenda, which was to be a review of the less-than-glorious results of the Newton project.

"What if our fanciful friend is correct?" Benaj Ritta from Mars Colony Kasbian said. "A supernova so close to the solar system would be a catastrophe."

"Blast it, man! There will be no supernova!"

Torrance sighed and sat back to wait out the next cycle of the argument.

He glanced across the chamber.

Emil "Oscar" Pentabill sat quietly in a suit that matched the wiry gray of his hair, listening and not adding to the conversation. He sipped from a white mug, jotted a note or two into his comm system, and glanced around the room, pausing only momentarily to stare at the conversation.

Why? Torrance asked himself.

What would motivate a man of science to turn his back on the people he worked for? What could take him over the edge of destroying everything with a single decision? The questions angered him. The whole thing was Pentabill's fault, after all. It was Oscar Pentabill's activity that had resulted in Torrance's assignment.

But Pentabill was not answering Torrance's questions.

The hotel hallway stretched ahead like a launch tunnel. The carpet was green and black with checkered patterns. Torrance looked for room 1512. Downstairs, the reception was beginning—cocktails and hors d'oeuvres at six, dinner at seven, and an informal presentation on FTL aging patterns at nine.

Pinot's agents had given Torrance more details about Pentabill than he felt comfortable knowing. Oscar had been married for twenty-three years but had no children. He was a quiet man who avoided the limelight. His habit at such gatherings as this was to eschew social drinks for quiet time with a martini and a trade magazine. He would arrive for dinner a fashionable five minutes late, eat a vegetarian plate, and play with dessert. Then he would excuse himself to turn in.

The number 1512 stood out in relief against the door.

Torrance pulled a magnetic locksmith from his jacket. The glass vial in his pocket was solid against his thigh. Bionites swam in its clear liquid, ugly critters—creepy-crawly things half-organic, half-machine, designed to systematically attack a man's nervous system, then dissociate into the cellular realms of his biology.

Torrance's palms were clammy. The scent of fear mixed with the dry odor of the door's latex paint.

The locksmith clicked against the wall. The processor spun numbers. Flickering digits fell into place. Torrance turned the knob.

The room was beige and yellow—bathroom to the left, bedroom large and

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comfortable. A Netvision rumbled from the far wall. Sheer inner drapes fluttered in the breeze of the balcony's open sliding door. The city splayed over the horizon below, a dirty tapestry of gray and blue as Cygni set on the opposite side of the hotel. Pentabill sat on a chair facing the city, his legs propped against the banister. The drapes obscured his shoulders and head. An iced drink sat on a knee-height table—a martini, complete with a local *dashtar* fruit skewered on a green swizzle. A portable reader lay propped on his lap.

The door shut with an audible click.

Oscar peered around the drapes, his expression more confusion than fear. A nested mat of his hair caught in the breeze.

"Torrance," he said jovially, collecting his drink and standing.

Pentabill must have seen something in Torrance's expression because he froze, one hand on the doorway's frame, the other dropping the reader mechanically to his side. His shoulders slumped. He was tall and slim, probably an athlete when he was a kid.

He swayed as if the drink was not his first.

Torrance put his hand in his pocket. The vial was cold and smooth, its cap small and ridged. The automatic hypo would react to sudden pressure. The injection would be quick and nearly painless.

"I'm sorry it's you, Torrance."

Pinot's evidence left no doubt that Oscar was guilty. He had to know it was only a matter of time before the United Governments would strike back.

"Why did you do it, Oscar?"

Pentabill's hand shook as he drank. "It's worse than you think."

"What do you mean?"

"Universe Three."

"Yes?"

Pentabill smirked, and tossed the newsreader onto the bed.

Torrance gave him time.

"Do you ever notice how we talk about decisions in the name of organizations—but organizations never make decisions."

"I understand that."

"I thought Casmir Francis would lead us in the right direction, but he's no better than the rest."

"What are you talking about, Oscar?"

Pentabill waved his drink around. "Doesn't matter, I suppose. Dead men tell no tales, eh?" He chuckled to himself and glanced at Torrance with an impish grin. "I did it, Torrance. Everything. Kransky-Watt. Exotic material."

"Tell me something I don't already know."

"I sold them Newton."

Anxiety was a moth under Torrance's breastbone. Pinot's cube said nothing about Newton. "Why would they want a failed program?"

Oscar pointed a bony finger. "UG would be best served to not underestimate Universe Three. Bright folks there—some of the best. Castenades went to their side, you know? He did you one better, too. Figured out how to set a remote link. It's trial and error, but within a probability range, U3 can create and destroy wormholes anywhere they want."

"You're kidding me," Torrance said.

Oscar's response was a wry curl of his lip and a shake of his head.

This meant Universe Three was ahead of the game. The star drive gave human beings the ability to travel faster than light. But remotely configurable wormholes would provide the ability to instantaneously step from, say, the Cassiopeia system where Casmir Francis was rumored to keep his home base, directly to, for example, Earth. And nothing could keep him from bringing along an army of an additional ten thousand men.

"Are you sure?"

"I've seen the work." Pentabill took a slug from his drink. His face was shadowed and drawn. He looked tired.

"There's more, isn't there?"

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"Black holes." Pentabill's knuckles became white around his glass. "It took a few tries, but Castenades has planted the end of a wormhole in the middle of a black hole."

"Holy Mother of God."

"The other end is going into Alpha Centauri A."

Torrance was taken totally aback. "I don't understand."

"He's trading spacecraft. Simple math. Alpha Centauri fuels ten spacecraft. *Icarus*, and nine UG craft. Kill the star, kill the spacecraft."

Icarus was one of the spacecraft involved in the Cassiopeia incident, the event where the Universe Three rebellion first manifested itself. They had captured *Icarus*. A year later, powered by Oscar Pentabill's treachery, U3 was a bonafide wormhole power.

"It could be worse than that, too, right?" Torrance said. "The physics of that configuration gets calculated as if the black hole were actually inside the star, and we have no way of knowing the mass of the black hole Universe Three is connecting to Alpha Centauri. A massive black hole so close to the solar system could be dangerous."

"Like I said—no better than the rest." Pentabill breathed through his nose. "The world protects its own, though, Torrance. I used to believe Francis truly wanted the holistic world he talks about. But he's just another card sharp. When U3 activates the trigger, every United Governments spacecraft attached to the star will be destroyed. Who knows what's next? But one thing *I* do believe with all my being is that Casmir Francis will deserve whatever happens to him."

The handle to the door jiggled. Oscar's face went pale.

"Who is it?" Torrance asked him.

Oscar looked at Torrance with a pallbearer's grimace. This was a man putting his burden down and accepting his fate, and Torrance found the expression made him angry in a place down deep inside.

"Do me a favor?" Oscar said. "If you get a chance, tell Glory I love her."

The door swung open. A man wearing waiter's white blew past Torrance and collided with Pentabill. Oscar grunted. His glass smashed against the wall with the smell of gin. The man was big and quick—maybe juiced. He lifted Pentabill in stride and rushed to the balcony.

Oscar disappeared over the edge.

He did not scream. Did not even speak.

Torrance anticipated the thick sound of a body hitting the ground, but the impact was not audible.

"You're with Universe Three?" Torrance asked.

The waiter looked up. He was maybe twenty, with brown hair and an angular face. He flexed his hands, bent, and reached to his pants leg where Torrance could see the bulging shape of a weapon.

Torrance kicked. The waiter pivoted away and Torrance's foot crashed against the bed railing. His momentum carried him. His body twisted, losing balance, bouncing off the mattress and sprawling to the floor with a lung-crushing thud.

The waiter spun and locked onto him.

The gun was small—a laser weapon with charge enough for two or three good shots.

Torrance raised one hand.

Kalista McKenna, he thought.

Supernova. It was the only idea he had.

"If you kill me, U3 will be making a big, big mistake."

"Tell it to the bosses."

"Let me."

"What?"

"Take me to your bosses, and let me tell them about the mistake."

The waiter put his gun against Torrance's forehead.

"My name is Torrance Black. I'm a scientist from the Newton project. U3 is

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working without critical information. If you do what the man you just tossed off the edge of the world said you're going to do, U3 is liable to blow away most of the civilized galaxy."

The agent's face was impassive. The weapon's muzzle was cold against the front of Torrance's skull. He hoped his bluff was convincing enough.

"I can't leave you splattered here anyway."

Torrance released a breath he didn't know he was holding. He knew a bit of how this game was played. Soon the nets would carry headlines about Oscar Pentabill's suicide. Another body in the room would ruin that story line.

"Get up and let's go."

Torrance complied, straightening his pants and jacket as he went through the doorway.

The hallway was still quiet. Their footsteps were heavy against the carpet. The waiter strode behind Torrance, the fabric of his pants rasping with each stride.

They came to the elevator.

"Get in slow. Understand? No collateral."

Torrance nodded. "I understand."

The doors opened. Four people stood in the compartment. The doors were burnished bronze, reflecting images as blobs of color. The air smelled of humid carpet and light cleanser. The waiter edged behind him, the blunt point of the weapon like a fist against his kidney. They stopped on the tenth and took on another passenger. Two more on the third-floor mezzanine.

Sweat pooled on Torrance's brow.

What should he do when the doors opened? Should he run? Should he turn and punch?

How many people could die with a random laser shot?

The doors opened.

"Left," the man said quietly into his ear.

The lobby was large and open, but still crowded.

"Outside."

He walked across the pavilion. An automatic door opened as they approached the exit. The air at ground level was hot and stagnant. A gravcar pulled up and the back door opened to reveal a man in a business suit. Torrance could not see his face, but his hand showed another laser.

"Get in," the waiter said.

Torrance didn't hesitate.

The door slammed. The man was slim and smelled of soap. His hair was long and tied tightly behind his head. He reached across the bench seating.

A pinprick burned on the back of Torrance's hand.

His world went dark.

Somewhere in the deep swirl of dreams, Torrance decided that the question is not whether or not God plays dice. The question is what game he plays.

"Welcome to *Icarus*, Captain Black." The voice was distant and vaguely feminine.

"Wha—"

Bright light stabbed his temples.

His eyes burned.

A row of fluorescent lights lined the ceiling, ringed with halos of silver and blue. A pallet was hard against his back. Shadows with human form glided through his vision, shifting light like a kaleidoscope.

He was hungry.

Icarus? Why was that name familiar?

The man. A laser weapon. A car. Oscar Pentabill falling.

He took a full breath. Oxygen refreshed his body. Memory returned. Blinking brought things into better focus. A man in a blue medical uniform stood against the wall. A woman with auburn hair sat in a chair beside the bed.

"Get yourself cleaned up," the woman said, standing. "I'll order you something to eat."

The man leaned forward to read numbers from the monitor over Torrance's

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head. A guard came into focus on the opposite side of the room. The woman turned to the man in blue. "I'll report he's awake. Make sure he is presentable."

"Aye, ma'am," he replied.

Water rushed over him. The smell of soap was something normal to hold on to. The warm sting against his chest and shoulders made him feel human. He was stiff and sore, and the water brought him simple comfort.

Icarus was a carbon copy of *Orion*, a ship Torrance toured with for three years. The two were among the first star drive spacecraft ever designed, each built in cookie-cutter fashion to save cost and development time. They had been made with maintenance in mind—with service nodes placed at key junctures on every level. Each node provided access to the systems command center through sleek, holographic interfaces, the first to utilize such controls.

If Alpha Cen A was going to be tied to a black hole, he was sitting on a ghost ship.

He wrapped the towel around his waist and stepped into his quarters. His clothes were gone, replaced by a pile on the foot of the bed. The pants were baggy and gray, tied in front with a drawstring. The shirt was blue polyfiber that hung below his hips.

Breakfast was cornbread and freeze-dried apricots in the officer's mess. A carafe of coffee sat in the middle of the table. An armed guard stood outside.

The food did wonders for the clarity of his mind.

"Good morning."

Torrance sat up straighter.

The woman was middle-aged—no more than sixty—with blonde hair and a dark complexion that spoke of Latin heritage. She wore black trousers and a zippered sweatshirt with the *Icarus* logo sewn into the left breast. She was thin to the point of frailty. Her eyes were watery blue with dark half-moons beneath. Her lips turned down at the corners.

He took a swig of coffee and wiped nonexistent crumbs from the corner of his mouth.

The woman took a seat across from him. "I understand you have something you want to tell us?"

"I haven't decided whether to tell you or not."

"Choose your game carefully, Captain. Personally, I don't believe for a second that you have anything useful to say. And I resent the acrobatics we went through to rendezvous with you. But some people think you know something. They think you might actually be able to prove we're making a mistake. And unlike the United Governments, U3 actually cares about the galaxy."

"Sure you do. You care just enough to put a black hole right in the solar system's neighborhood."

"The solar system is *not* the galaxy, Captain. Besides, the people of the solar system will have quite a bit of time to find someplace else to go."

"But what if they like where they live?"

"Then they can stay until the end."

Torrance stared with disbelief at the woman. "Who are you?"

"I am Katriana Martinez, first officer on *Icarus*. More relevant at this point, I am responsible for forming the black hole link."

"I see."

"And you are Torrance Black, captain in the United Governments Space Force and one of the chief engineers on the Newton project."

"Your data is good."

"You have two ex-wives and a pair of daughters: Mercedes, who is currently stationed in a cryo research lab on Europa, and Cassandra, who graduates this spring from Canal University with a degree in accelerated-growth bioprosthesis. Your first marriage failed at least in part due to certain—" She paused and raised her eyebrow. "—deficiencies. Due to these same deficiencies, both

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daughters from your second marriage are adopted. They both tell you they live alone. Cassie is actually holed up with another young woman who is studying multidimensional mathematics. Mercedes is preparing to get married, and has been living off and on with the man of her choice."

A chain reaction of images clouded Torrance's mind. Mercy was getting married, and Cassie—who had always had such a painful shyness about her—had someone special in her life. Why hadn't they told him? He never thought he was overbearing about such things. Maybe that was the problem.

Martinez's stare was filled with accusatory sternness.

She reached into a sweatshirt pocket and set a small vial on the table before her. It was the bottle Torrance had taken to Oscar Pentabill's room. Cold light from the ceiling reflected from its surface. Martinez put it on its side. It made a hollow sound as she rolled it from hand to hand.

"Do you know what's in here?"

Torrance shrugged, trying not to concentrate on the shiny bottle of micro-sized death.

"Bionites, Captain Black."

"Really?" Torrance said with innocence.

Martinez was having none of it.

"Are you threatening me?" Torrance said.

"I don't need to threaten you, Captain. You're already a dead man."

Torrance stared quizzically at her.

"You've surmised that *Icarus* will be destroyed when the black hole is set."

"Yes."

"What you don't know is that *Icarus* has been given the honor of actually creating the link itself. We are nearing launch now."

"We're in the Centauri system?"

"Yes."

"I thought you could set links remotely."

"We can."

"Then why send *Icarus?*"

The first officer smiled. "I'm the one asking questions. You gave us a cryptic warning about blowing up half the galaxy. I want to know what you've got."

Torrance thought of Oscar Pentabill. He had said U3 could set links in any location they wanted to *within a ring of probability.*

"You can't control the mechanism yet," Torrance replied. "Your remote capability is fine when you have enough space to cast about. But now that you've got a black hole attached to one end, you can't afford to drop the other end willy-nilly, can you?"

The intensity of Martinez's gaze let him know he was right. "Doesn't matter either way, does it?"

"So you'll set a link like *Everguard* did."

"Almost."

"What do you mean, almost?"

Martinez's entire face lit up in a maniacal smile. "*Icarus* herself will be part of the final mission."

"I'm not sure I . . ."

Sudden understanding made his skin contract. He sat, staring dumbly at the ship's first officer. "You're going to set the pods by flying *Icarus* into the star."

"It fits our sense of poetry."

Torrance stared at the glass vial Martinez was still rolling on the table. Who was this woman? he thought. What had her life been that she was willing to give it away so freely?

"*Icarus* is not designed to withstand the heat of a star's core like the pods are. We would burn up before reaching the proper trigger point. But the ship will get sucked into the wormhole as soon as the pods are activated anyway. So we'll get as close as we can before we launch."

"Launching from that close should reduce your probability of error," Torrance said.

Martinez grew smug. "This might be a good time to talk to me, you see, be-

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cause if you are bluffing you will die with us, and disappear into so many particles blowing on Centauri's solar wind."

She held the vial still with the fingertips of one hand.

"Besides that, U3 has operatives on every inhabited station around the galaxy—specifically including Europa and Mars. It would be a tragedy if a vial just like this dropped into a young woman's breakfast cereal." She paused, rolling the vial once. "If you have something to tell us, now might be a good time."

He set his jaw.

He had nothing to tell them that they hadn't heard at the conference, but this was no longer a simple game. He had to do something to stop this mission. There was no other answer. He had to disrupt the launch, and he had to destroy their communications system before Martinez could give any order in regard to his daughters.

The first step, though, was to get out of here.

He looked at the vial. It still had its injection cap.

Torrance waited until the vial was in mid roll.

He lunged.

Martinez's fingers tightened, but the vial slipped away, wobbling and clattering across the white tabletop. Four hands scrabbled after it as it dropped over the edge. It hit the floor with a solid thunk. Torrance leapt from his chair and grabbed it. He followed his motion, standing and wrapping an arm around Martinez's waist. He turned the vial in his hand and put the injector to her neck.

His elbows and hand ached with the pressure of his grip. The room seemed to suddenly contract. "I want out of here."

"This is a mistake, Captain."

"Let's go," he said, prodding her with his hip. "Now!"

"Where?"

He thought.

"Pod Engineering."

As they stepped toward the doorway, the enormity of what he was doing closed in on him with the crushing weight of the ocean.

He had always heard that a man's life flashes before him when he is about to die. Torrance saw images of Cassie and Mercy. Fresh-faced, clear-skinned men and women marching into battle cruisers. A star exploding, burning tracers of plasma spiraling into vacuum like twisted arms of jellyfish under Europan seas. He saw Alexandir Romanov, his captain from *Everguard*. Admiral Hatch, the man in command who had never known the risk he had taken in ordering a wormhole set.

And he saw Eden, a cloud-covered planet floating in this same churning sea like a long-lost island overgrown and ugly, unworthy of second thought.

The door slid open.

The guard glanced over her shoulder.

Torrance pulled Martinez closer and pushed past, holding the vial to her neck. "One step and she's dead."

The woman raised her weapon. She was young, with dirty-blonde hair and round brown eyes. Red energy flared. The odor of fried brains and scorched hair was everywhere at once, and Martinez's body was dead weight in his arms. Torrance's gaze went to the metallic muzzle of the weapon that had just put a fist-sized hole in the first officer's forehead.

The guard gave a gap-toothed grin. She was short, with smooth muscles that showed through her uniform. Her face was set and hard, his eyes showing humor at Torrance's confusion.

"I told 'em again and again there weren't no reason to play your game," the guard said.

Torrance dropped Martinez's body, tore the lid off the vial, and held it like a knife. "Do you know what this is?"

"I don't care."

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"You should. If these critters touch you, you'll die quicker than you can pull that trigger."

The guard shrugged, but her gaze locked on the vial.

Seizing this advantage, Torrance threw the open container at the guard and bolted for the corner. She screamed and jumped back. Ten meters to another corridor. Footsteps came from behind. He ran, confused by the lack of foot traffic in the corridors—*Orion*'s hallways had always been teeming. His joints ached and his muscles were putty.

The girl was probably in shape.

In a flash of insight, Torrance understood the empty corridors. This was a suicide mission. *Icarus* was being piloted by a skeleton crew—just enough to keep her flying.

He came to a maintenance alcove and entered a standard service code. A control holo spun before him. He toggled the fire systems. Carbon dioxide foam hissed in the hallway. The guard's surprised yelp echoed from around the corner.

Torrance did not look back.

He raced to the lifts, each of his seventy-one years weighing in his lungs like lead.

"Central Ops," he said.

And he waited.

The lift's hydraulics creaked in the silence. The sound of the guard's footsteps drew closer. She coughed and said something that Torrance assumed was a call to whatever crew was aboard.

The lift arrived. The door opened.

Torrance stepped in.

The guard rounded the corner, her hair soaked and dripping, her gray top matted to her body. She raised her weapon but the door closed before she could get off a shot.

The lift dropped.

His heart clattered in his chest. The system hummed around him. He looked at his empty hands. Never before had he felt such a terrible understanding of what it meant to be defenseless. The lift doors opened. Torrance ducked in anticipation of other guards, but there were none.

Pod Engineering was around the corner.

The deck's power system was to the left.

He could do some serious damage by playing with the power grid—maybe create a diversion that would leave him free to work the pods. The system's security, however, was tricky. If he didn't get in, the advantage of his head start would be gone. To hell with it, he thought. No time to play games.

A light flickered from atop the lift, indicating the platform was nearing its destination. His time was short.

Torrance found a service bay near the lift. He pressed an entry code and accessed the lighting system. The hallway went dark. Luminescent rows of crimson emergency lights flickered on along the hallway. The controls on the maintenance panel glowed dimly.

He looped around to take a path to Pod Engineering that wouldn't lead him past the lift. He heard the door open. Silence was palpable. He followed the crimson dots. The hallway was arched above him. The air was thick, and he found it difficult to breathe for fear of making so much as a wheeze.

A crossing corridor loomed ahead.

It should take him to Pod Engineering.

Torrance glanced around the corner. Empty hallway. The double doors to Pod Engineering were dead ahead, on the opposite side of a corridor making another T with this one. The hallway behind him was empty, too. The guard was somewhere, though. The lift door had opened. She was on this floor, weapon at the ready. But which way would she come?

He had to choose. Fifty-fifty.

He took a breath, turned the corner, and strode with long, heronlike steps toward the double doors. By the time he neared the T, he was nearly running. He

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stepped like a shadow across the open expanse of the hallway, then knelt in the alcove outside Pod Engineering's door.

Voices came from a distance. More crew.

The hallway leading to the lift was empty.

She had followed him around.

He pushed an entry pad. Both doors rasped open. Light from inside extinguished the hallway darkness. Torrance stepped in and pressed the panel on the opposite wall. The door closed.

He ducked down and sidled up against a barrel painted blue. The place felt huge and smelled of electricity. The barrel was cool against his fingers. He rested his forehead on the barrel's surface to catch his breath. He was sore and tired from running. His calf muscles felt flayed.

Pod Engineering lay below him, the open "pit" and row upon row of drone pods several meters down. The second-floor control center looked out over the pit from its perch, its walls consisting of a belly-height wall and plastiglass extensions that rose to the girded ceiling.

Three technicians worked on a pair of wormhole pods in the pit. Torrance counted eight tubes closed and locked.

Staggered rows of olive-coated ion torpedoes lined a distant wall. A gritty calm spread over him. Every torpedo had a detonation sequence that could be programmed to provide a sequenced time-on-target capability. If he could detonate a few torpedoes, they would certainly destroy the pods. If he could get to the entire rack, it might well be enough to take out the entire ship.

He ran his tongue over his lips, tasting sweat and grime.

A pair of engineers hunched over a holographic display in the command center, probably loading navigation parameters into the pods. The weapons calibration station was in there.

Destroying *Icarus* here would stop U3 from planting the black hole and keep them from radioing home. It was enough for him.

It had to be . . .

. . . or did it?

The shuttle bay was a short jaunt from Pod Engineering. While a shuttle could never make it all the way home, it was certainly capable of sending messages back to the solar system. He would never live long enough for the message to arrive, but if he could launch himself before the blast, and if he was very lucky, a star drive spacecraft might happen upon his derelict shuttle in time to save him.

At worst he could make sure someone knew what had really happened.

It was as good a plan as he was going to get.

He crept along the curved wall toward the command center, trying to stay out of sight of the workers below. A minute later he knelt against the wall below the field of view of the windows.

The door was open.

"Pod nine loaded." The voice came from the communications system—a technician relaying status from below.

"Thank you," one of the engineers said.

Nine pods loaded. The tenth would be complete soon. Eight was enough to set the link. He had to move.

"How long until we go black?" the other engineer said. He was nervous. Not surprising. Torrance would be nervous in his shoes, too.

"I don't know."

"Pretty close. One more."

"Maybe fifteen minutes."

It was quiet.

"Probably less."

"Then there's flight time."

Torrance peeked through the plastiglass. Guidance and launch control lay directly ahead, maintenance to the left, inventory to the right. The weapons calibration station was just out of his field of view.

If he could draw the engineers near, he could catch them off guard. He positioned himself at the edge of the door, then scratched quietly against the metal-

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lic edge of the frame.

Neither engineer reacted.

He scratched louder.

"What is that?" the nervous one said.

Torrance stopped.

"What?"

He scratched again.

"That."

The floor was tile. Footsteps drew near on the other side.

Torrance sprang forward and threw his shoulder against the closest engineer. The whumpfh of air leaving lungs accompanied them as Torrance fell tangled atop the engineer. He rolled forward, stood, and caught the second engineer with a right cross that sent shivers of pain up his wrist and forearm. The man fell like a sack of potatoes.

The first engineer rose to one knee, his hand rubbing the back of his neck. "What are you doing?" he said.

Torrance took two steps and kicked.

His foot struck the man's jaw and sent him spinning away. The back of the man's head hit the corner of a desk with an ugly thud, and he fell limply to the ground. Torrance stared at the man with a surrealistic sense of the absurd. Had he just done that? Was the man dead?

The second engineer groaned but did not move.

Torrance went to the weapons station. It was active.

He paged through screens, his fingers shaking with adrenaline. Too long—it was taking him too long. He found the screen entry system, selected a torpedo, and set the detonation time for seven minutes. The next he set at seven, and the next, and the next. The work went smoothly once he had the rhythm. When he had keyed them all he reset the system, closed the screen, and opened a security layer that locked the display against manipulation.

It would be almost impossible to find and fix them all now.

He started the system counter.

That was that. The code had been sent. The torpedoes armed. He had seven minutes to find the shuttle bay.

A footstep sounded behind him.

The area lit up in scarlet flame. The weapons station exploded. Torrance leapt away. The woman stood in the doorway, her gray uniform streaked and smeared with grime, her hair dangling in short ringlets. She trained her glowing weapon on Torrance. Her eyes, dark and cold, told him her first shot was no accident. She had taken out the station to keep him from completing whatever work he had been attempting.

She was too late, of course. The code was in the torpedoes by now.

But he was her next target.

A ventilation grate was mounted on the near wall. The grills were plastic, about three meters long and one high, mounted a bit off the floor.

Torrance half dived and half leapt at the duct, rolling to strike the grating with his shoulder. Plastic splintered around him. Laser ozone cut into his nose and throat. He crashed into the duct, slipping on the dirty floor. Pain lanced his ankle—was he hit? He crawled, scrambling on his hands and knees into the darkness like a psychotic crab. His leg throbbed but he kept moving.

Clamoring echoed from behind. Metal reinforcements of the ductwork bent and popped.

The woman was following.

He was afraid then, afraid with a frozen fear—a sensation like falling. He wanted to live. Maybe it would be for only one additional breath, maybe for only a minute more—maybe for a mere week in a dingy shuttle floating out in space. But there in the darkness of *Icarus*'s ductwork, Torrance knew that more than anything, he wanted to live.

His fingers slipped in the grime. The place smelled like oily linen. He crashed painfully into a wall ahead. His ankle felt like a railroad stake had been driven through it. His ragged breathing echoed with reverberations that made the world small and claustrophobic.

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Raw fear pushed him onward.

He took the left passage, thinking it the most likely to lead to the shuttle bay. A flash colored the duct crimson. The smell of hot metal brought a stifling pall to the chamber.

Torrance crawled over a heavily buttressed segment of the flooring—vacuum containment element—that marked the perimeter of the bay area.

A grating loomed. He threw himself into it. The ground knocked the wind out of him. The world swam. He thought he might pass out from the pain in his foot. Three shuttles sat in a line like massive green insects. Men raced in from the main bay entrance. Laser fire was suddenly everywhere. He crawled behind a landing strut to avoid being an open target.

The closest shuttle's ramp was open, maybe two meters away.

Gritting, Torrance launched himself. Something bit his thigh.

The rubber pad lining the ramp burned with an oily reek.

He dragged himself into the shuttle.

His pants were charred and smoking. His leg burned with pain. The shuttle airlock was still open. Footsteps scrabbled below. He dragged himself to the cockpit, each move making him suck air against knife-sharp pain. He pulled himself to the captain's chair and keyed the hatch system closed.

The craft shuddered.

Holding a nervous breath, he commanded the bay doors. They irised into six elements, dilating away.

He almost cried with relief.

Rockets on. Firing. Docking release made. Yaw commands steady. Right attitude. Trimming thrusters active and warmed. He pointed the craft out the doorway and crammed the engines.

The shuttle slid forward.

Zero-g took over as he left the ship's autograv field. Torrance nearly choked on raw emotion. He was in the umbra of *Icarus* against Alpha Cen. The blackness of vacuum was an open horizon in every direction. The stars glittered like pinpoints of glorious, glorious freedom.

Icarus fell away.

The brightness of Alpha Centauri A burned through the windshield. Torrance deployed a protective screen and looked at *Icarus*.

Would he be far enough out when the torps went?

The briefest flame roared from a launch tube.

At first Torrance thought this was the explosion of torpedoes. But instead, a black silhouette belched from the flame, a needle-shaped figure Torrance would know anywhere.

A wormhole pod.

Then another and another until there were ten pods flying, rocket engines engaging, turning, looping about, before taking a course toward the blazing star.

A hole formed in Torrance's gut.

Somehow, through the confusion and the turmoil, with two engineers knocked unconscious, somehow *Icarus* had launched the pods.

He pounded his armrests, cursing aloud, feeling powerless and shrill.

Then the torpedoes blew.

The explosion started at *Icarus*'s forefront, fragments peeling silently from the surface, debris racing haphazardly into blackness. Flames spouted and died. The ship buckled. Torrance watched with detachment.

When it was over, *Icarus* looked like a trick cigar, one end charred and serrated, the other slim and perfect. This bird was dead, its guts ripped by pyrotechnics and vacuum.

Torrance closed his eyes. Deep space was obliterated by proximity to Alpha Centauri's brilliance, but he knew it was out there. He thought about wormhole pods. He thought about black holes. He thought about Willim Pinot smiling. He thought about *Icarus* floating breached in space.

And Torrance was struck by the thought that perhaps human beings really *were* alone—that perhaps there tru-

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ly was no greater power left in this world than the men who had created the wormhole pods that were flying at this moment so very close to the sun.

Now that he had time, Torrance stared at his leg. It was burnt and goopy. A small laser hole was burned through the fleshy place between his Achilles heel and the bone of his ankle. It felt like he had been skinned, then dipped in rubbing alcohol. He tried to prop it, but moving it brought tears to his eyes. He tried to pull the cloth of his pants away, but merely touching it was razor on bone.

Finally he decided merely to rest.

He gathered his senses.

This was it. He was floating four light-years from home without an oar. The pods would make Centauri A in a few hours. He twisted to check the freeze-dry. Enough food for two weeks if he skimped—maybe.

He knew what he had to do.

He flipped on the radio. The message would take over four years to arrive at the solar system, but radioing home was all he had left, so he did it.

"*Icarus* is dead," he said. He explained U3's plans for a black hole. He warned of their threat to kill his daughters, and he asked for someone to look for them. He described the flight of wormhole pods and what that might mean. He gave them his coordinates, then finished by telling Mercy and Cassie he loved them. "And do the same for Oscar Pentabill," he said, remembering the man's last wishes. "Tell his wife . . . tell Glory . . . that he loved her."

He clicked off the message and set it to replay every thirty minutes, casting each upon the turbulent waters of the vacuum to drift in its own invisible bottle of time.

"Maybe," he said aloud, "someone is close enough to—"

He stopped.

He remembered the icon flashing on his wrist. That moment seemed so long ago. So far away. He looked at his fuel monitor. There was enough.

He flipped the radio back on. "Strike those coordinates," he said, as he punched up his navigation screen.

Inertia shifted as the shuttle came around.

The planet came into view, a pinpoint of light against the black sky. The ship computer indicated something over twelve standard days to make it there. He hoped the atmosphere would support him. He hoped whatever life was there would help him.

In the end, though, he was surprised to find it didn't matter. His chest welled with a new sensation. After all this time, at least he would know, and this knowledge alone was enough to bring him a sense of peace he had never before felt. This was it. This was what his life was about, perhaps what God had made him specifically to do.

He commanded the engines on full.

"I'm going to Eden," he finally said. "If it's still possible, come and get me."

And he flew toward the planet, a man encased in the cocoon of his spacecraft like parchment in glass, preparing to wash up on a distant shoreline—a message unto himself.

Or, perhaps, an answer.■

(EDITOR'S NOTE: This story is a sequel to "Stealing the Sun" [October 1999] and "The Taranth Stone" [October 2000].)

The future belongs to those who prepare for it.

—Ralph Waldo Emerson

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DNA Royalty

Kyle Kirkland

Few would dispute the value of archiving important bits of history, but how far should it go?

My twin brother, Baron Hermann von Steuben, has always been troubled. I love him but Hermie never really fit in.

At the age of five he quickly realized that he couldn't run as fast or jump as far or think as well as the other kids. And that bothered him—a lot. I've never been able to imagine why. It never bothered *me*. Why should it? We have people to do these things for us.

But Hermie, well, he just never understood. It got worse as time went on. Every once in a while, when someone genuflected or bowed to him, he'd cuff the person's ear.

I watched as they brought my now nineteen-year-old brother in from his latest, and most pathetic, escape attempt. James must have run out of sedative for, unlike times past, Hermie was very much awake and very much aware of his present indignity—draped across James's massive shoulder, and bound hand to foot. As James walked past, I saw Hermie, his face as blood red as his tunic, glaring at me. Undoubtedly only the gag in his mouth kept him from unleashing a chorus of curses on me.

You see, I—The Excellent and Most High Nathaniel IV—failed to help him again. I warned him I wouldn't, but Hermie persists in the belief that one day I finally will. He insists it's just a matter of time. Since we're identical twins and have the same genes, his argument goes, can we be *that* much different?

Come to think of it, perhaps I've been guilty of the same faulty logic. All this time I've kept thinking—and hoping, dearly hoping—that Hermie will ultimately realize that he's wrong, and come over to my way of thinking.

Mother and I followed James into the family room, the echoes of James's giant steps softened by the colorful banners hanging from the walls. He stopped at the semicircular settee which partially surrounded the crackling fire and flue.

Mother was of course terribly flustered. She pushed back her crown—she was wearing the scarlet one today—on her slightly graying hair (which she left gray for some sort of regal effect).

"I refuse to believe," she said in an exasperated tone, "that this has happened yet *again!*"

James placed his burden carefully on the settee. "Your majesty, my most gracious Queen, forgive your unworthy servant for contradicting Your Esteemed Word. Young master Hermann has indeed attempted to flee the royal grounds."

"Mom," I said. "Mom—"

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"Hermann, Hermann, how many times," said Mother, enveloping him in an embrace. Working around Mom's ample body, James managed to get my brother's bonds loose. Hermie flexed his arms once and rubbed his wrists, but otherwise just sat there like a lump—a lump with a very sour expression.

"Mom," I said, finally getting her attention. "Let me handle this. Please?" I nodded a dismissal to James.

Mom turned to look at me with her practiced severity. "Nathaniel, you must get Hermann to understand that one does not do these things. That one may get hurt. That this is unacceptable behavior for nobility. You must get Hermann to see reason."

Fat chance. Been there, done that. Zilch, no score.

I urged Mom to leave, which she did after giving our "wayward charge" a peck on the cheek. I love Mom as much as I love my brother, but both of them can be tough to deal with sometimes.

I sat down beside Hermie and waved away some of the smoke that was drifting toward us from the fire. Once in a while one of the logs would pop and a glowing yellow spark would trace an arc through the air.

Staring at Hermie, I made sure he had no serious injuries—the servants sometimes forget that members of the royalty don't self-repair—and then I let him sit there and sulk a while. I'd already made up my mind what to do, even though I hated myself for it.

Long ago I'd gotten used to seeing a copy of myself when looking at my brother. There were differences, of course, that he and I have noticed—and sometimes relished—over the years, and Mother can tell us apart. (Sometimes I don't think Dad can, but he always claims otherwise. Of course James can very easily do so.) Hermie's hair is the same auburn color, perhaps a shade more brown than mine, and we both part it on the left side—a "natural" part for us, the Royal Barber says, and he insists that we wear it so. Our faces have the same squarish structure, but Hermie's nose is just a tad more upturned than mine and slightly asymmetrical: the left nostril is a smidgen larger than the right.

Small differences, but noticeable—to us, at any rate. And of course our tunics were always different, so that anyone could distinguish us while we were thusly dressed. Everyone knew that Hermie loved the color red and wore it every chance he got—whence his baronial title, given to him in honor of some ancient and legendary fellow who no doubt enjoyed his sanguinary reputation.

I, on the other hand, am fond of blue. Deep, rich blue, like you see in the ocean just before sunset or just after sunrise.

While I was trying to gather my thoughts and the words that I was going to put them into, my brother surprised me by speaking first. "I thought I'd get away this time, even without your aid," he said, in that morose tone of his. "I read of a way to throw James off my trail."

"Throw James off your trail? Come on, Hermie, you know he's ten times better than a bloodhound."

"A red herring, Nate! I had a red herring and I dragged it across my path. It should have worked."

I shook my head. "Silly boy. That might work for dogs, but why would James be distracted by a dead fish?"

"But the scent—"

I frowned. Hermie and I have read and studied widely during our many idle hours, and my brother is smart—but impulsive.

Hermie sat there silently a few minutes, watching the fire. Then he said: "Such amazing abilities. God, it would be fantastic to be able to smell like that. You could smell something just from the presence of a few molecules."

He turned to me and suddenly grew animated, an exuberance I always found

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so frightening. "Why won't they let me have even that, Nate? I've read about it, it wouldn't require a *change* in my genes. Just a change in gene *expression*—strong sensitivity to odors can come from having a large number of receptors. I can keep my own receptor genes but increase the number of times they're made into proteins!"

"No, Hermie. No change whatsoever."

"Oh, that's right, of course," said Hermie with a sneer. "The pristine genes of the nobility."

"Genes and gene regulators. Why can't you understand? There's not that many of us left. Our DNA is untouched by human hands—it's never been tinkered with. Isn't that worth preserving? And not just in a dish or on paper, but in real flesh and blood?"

Hermie slouched like a suddenly deflated balloon. "A living fossil."

"No. Royalty." Eyeing him warily, I asked, "Cozumel? Brasilia? Or was it going to be Kiev this time?"

"I'm not telling," he said, crossing his arms.

"If you ever do finally get into one of those no-questions-asked gene parlors, my dearest brother, there's no turning back."

"Would that I could get there, Your Excellency."

I stood up. The one thought that kept racing in my mind was, "you stupid little bungler," although I didn't know which one of us was being referenced—Hermie or myself.

Both, perhaps. I told Hermie what I'd decided.

A human with the standard vision augment VisEX could see quite well on a moonless night, but with the extra cloud cover and the sheer blackness of the castle grounds and the moat, I felt pretty sure that none of the servants would spot me, if they happened to pass by a window.

I tied the cross-rail of my little canoe to the rope and lowered it over the parapet. The moat was forty feet below and I paid out line until I heard a gentle splash.

Hermie and I, a long, long time ago, used to play together in these little canoes. We'd sling play-arrows at each other or grapple in hand-to-hand combat. The moat was actually a large lake covering several acres, and stocked with a steady supply of sunfish and largemouth bass. Along one shore there was a forest clothed in willows and pines and decked out in many slithering vines and thick grasses; it was to this shore I was headed.

After double-checking that the line was secure, I climbed over and made my way down to my waiting vessel.

The castle walls had a gritty, dirty finish, a crumbling sort of facade, giving it the venerable look of old age and steadfast purpose. Except I knew that it was less than twenty years old, and had been built, I was told, as a wedding gift for Mom and Dad. Despite its youth, it was a fine "old" castle.

Once in the canoe, I untied the line and cast myself adrift. There was a wickedly cold wind coming over the water, and I wished that I'd brought a sweater. But no matter: I'd be warming up soon enough.

As I paddled across the moat, there was time for all the doubts and second thoughts to enter my mind. My brain was finally taking in the fact that I was actually going through with this ridiculous thing. The chill of the breeze, the damp air laden with fish odors, the ribbits of the bullfrogs nestled along the far shore, reminded my senses of the task at hand. There arose a flurry of new concerns in my thoughts. I hadn't taken into account this, that, or the other thing.

I put them out of my mind and paddled on.

I paddled slowly, not in fear of capsizing, but just to ensure that I left a sufficient trail for James to follow. Of course it was highly unlikely, probably even im-

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possible, that he would miss it. I was just being paranoid.

It also gave me time to think.

Why was Hermie so different than I? We had the same genes, as he so often reminded me.

Genes aren't everything. Experience matters too. But somehow I never could get rid of a lingering and unpleasant sensation that Hermie and I *should* be in agreement on the question of DNA royalty. And that one of us was therefore wrong—or if not wrong, at least not being true to oneself.

And if it didn't matter that we had the same genes—if that wasn't so important—then what's the point of preserving "pristine" DNA?

Mercifully, the lake bottom grazed against my canoe, and I pulled the boat ashore.

With one last glance at the castle (which was just a dark outline against an only slightly lighter sky), I turned and began running. It was all easy now; easy in the sense of needing no thought, no strategy. All I had to do was run. And wait for the inevitable.

I passed one of the guard shacks on the lake's edge. It was illuminated by a faint exterior light. They were built to resemble old, collapsing fishing sheds, although inside they were comfortable enough. There were supposed to be guards posted there, to prevent just this sort of happenstance, but there were none in this particular shed tonight. (And one other shed.) Our servants were genemods but they could be bribed; thank goodness there was no such thing as an anti-greed gene. Yet.

But my very presence tripped the alert cam, and even if James had not already known about my escape attempt—which is doubtful—he knew it now. Soon he would catch up to me. Too soon.

My lungs burned, my heart pounded, but I didn't let up. Twigs cracked in my path, low-slung branches scratched and clawed at my face, but I kept up a good pace.

Even so, after only a mile I heard commotion behind me. Despite my best intentions, I stopped and listened, although I knew that the noise could only be that of James, loping through the woods with grace and remarkable swiftness.

Only a little farther, I told myself, as I gasped for breath.

And it was a very little way indeed, as it turned out. James caught up with me only a moment afterwards.

He grabbed me roughly by the collar. "That's enough, my young Baron." He turned me around, facing him. A strong light shone on my face.

I held my breath. Here's the *real* test.

"I'm quite disappointed in you," said James, "running again so soon. I'm afraid this will require a bit more serious discussion. The Queen will be most displeased."

James could see my tunic—red, of course—but he could also see my face. Quite well. Yet he saw me as Hermie.

So many things are genetic. Like body odor. Bloodhounds can't tell the difference between identical twins, and my brother and I were betting everything that neither could James.

But more than that: We had to bet that James was going to see what he expected to see. He had followed what he took to be Hermie's scent for the last few miles—it was certainly not unusual for him to do so. And then the red tunic. In his mind, genetically modified though it was, he made a humanly natural mistake: he saw Hermie, not me.

James said, "You're coming peacefully this time, my dear young fellow, I hope?"

I didn't want to risk speech, so I just nodded. Besides, it wasn't over yet: there was one last hurdle to clear.

As James and I walked back to the moat—to his motorboat, no doubt—I took my time (but not so much as to invite being carried). James was turning to say something to me, probably to tell me to hurry up; just as his beeper went off.

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A voice split the still night: "James? You there?"

James fumbled with his coat, and pulled his communicator free. "Yes. I've apprehended our refractory young baron, once again."

After a pause, the speaker said: "Well, it looks like his brother's taken off too. According to a palace guard, he lit out shortly after you did."

James paused. I froze.

"Which way did he go?" asked James.

"The opposite way you went."

"OK," said James—after what seemed like five minutes. "He's just looking for Hermann too—you know how close they are. But I guess he took the wrong bait. Hermann laid a false trail on the other side of the castle—it only took me a second to see that it was a fake. But Nathaniel must have been fooled." James lowered his voice and snickered softly. "You know royalty." After stealing a glance at me, James continued: "He'll be back once he realizes his mistake. Don't worry about it."

We continued on, and I think James tried to speak to me once or twice, but I wasn't listening. I was thinking of Hermie.

I wondered what sort of life he would have. And whether, a year from now, he would still thank me for what I'd done for him.

Knowing Hermie, I suspected that he probably would. ■

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Probability Zero

Ego Boost

Ian Randal Strock

"You mean. . . ?"

"Yes. We've discovered a way to tap into the human ego center. It's all very complicated—part of the time-matter-thought-energy equivalence. But suffice it to say, I started with the old saws about the power of positive thinking and it's the thought that counts, and I realized that they might literally be true."

"But then why hasn't anyone else ever discovered the ego center of the human brain?"

"Because there is no 'ego center.' It's a field generated by the entire brain. It's more akin to reading an aura. At any rate, we've discovered that people with bigger egos generate bigger ego fields, and we can tap into those fields."

"What kind of power output are you getting?"

"We'd originally hoped merely to get measurable energies. We almost gave up after the first few trials. Then I realized that perhaps grad students wouldn't be the best subjects.

"We moved on to a few openminded faculty members, but again, with less-than-stellar results.

"Finally, I hit upon a brainstorm, and went to the drama department. Acting students led to working actors, and we eventually hauled in a few movie stars. We had some successes, and the hope of measurable energy turned into a dream of useful energy. But we realized that the average movie star craves the public adulation, which is why he needs so desperately to be in front of the people all the time. There is some ego there, but not much.

"Then we moved on to rock stars: same basic problem, though with a greater ego power output.

"Politicians . . . well, it was hard enough to find one willing to participate in the trial, and we kind of figured that any politician willing to test empirically the size of his ego probably didn't have a very large one. We were right."

"Then how. . . ?"

"How are we going to the stars? Elementary. If you look at our data, you'll see there's an almost precise inverse relationship between the amount of public adulation our supposed ego hogs receive and the true strength of their egos. Politicians, movie stars, rock stars, in increasing order of strength. So we went looking for people who absolutely must have big egos to do what they do, while at the same time receiving almost no public notice."

The reporter glanced at the professor's book shelves. "You mean. . . ?"

"Yep. Who else but the world's biggest egos could labor for months in solitude to ultimately produce something that will generate mere pennies for their time? Science fiction authors. The starships *Ellison*, *Resnick*, and *Burstein* launch next Tuesday."■

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A PRIMER ON PROOF

Any kid under the legal drinking age is acutely aware that to buy booze one must be able to show proof of age. This "proof" is usually in the form of a driver's license. A driver's license with a false date of birth will work just as well as an honest one so long as the birthdate modification is done at all carefully, or if the clerk who asked to see it doesn't look too closely. Of course, this means that such an easily altered thing as a driver's license may not be proof of age at all. At best, a driver's license is *evidence* of one's age, leaving open the question as to whether it is good or bad evidence.

Even if the license is a fake, as long as the kid succeeds with it once, he is likely to succeed with that same clerk again. Indeed, as long as the clerk remembers him, since he already "knows" the kid's age, the clerk won't even look at the license again. This success could propagate if a second clerk recalls that the first one always sells booze to this kid without checking his license.

Bear the above example in mind as we continue.

People often use the words proof and evidence interchangeably and incorrectly. In ordinary conversation this error seldom matters. But when discussing controversial matters, particularly in science, making the proper distinction between the two words can be critically important. I often run into the problem of people failing to make the distinction when I read my mail or peruse various online fora.

In almost any documentary program about "strange science" matters, such as UFOs or psychic powers, it is a given that some quoted skeptic will, at some point in the program, say, "Extraordinary claims require extraordinary proof." When put this way, the statement is nonsense, and obviously so if one but considers what the word proof is supposed to mean. However, the statement that, "Extraordinary claims require extraordinary *evidence*" *is*, potentially, a valid one—at least this is a statement about the truth of which learned people can discuss and come to respectful disagreement. We will come back to considering what "extraordinary" means.

It is not my intention herein to give rigorous definitions of proof and evidence suitable for philosophers. I simply want to be able to carry on a conversation with any of you readers, perhaps at a con or via correspondence, without confusion about the two words getting in our way.

One neat way to highlight the difference between proof and evidence is to consider the rising and setting of the Sun. In pre-Copernicus days, that the Sun rose in the morning and set at night was clear proof that the Sun moved around the Earth. After all, you could see it with your own eyes. However, after Copernicus, the rising and setting of the Sun became proof that the Earth rotated. Now, the same observational fact could not be proof of two mutually contradictory hypotheses. But, the same observational fact *can* be evidence in favor of (or against) contradictory hypotheses. The rising and setting of the Sun is equally good evidence in favor of both the Geo-

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centric and Heliocentric views. But it is an observational fact unsuited to determining the truth or falsity of either idea.

In addition to knowing the difference between proof and evidence, it is also necessary to clear up some confusion about what can or cannot be proved.

Most of you are familiar with the expression, "You can't prove a negative." Although it is true that there are some kinds of negatives which you would be hard pressed to prove, the expression is not, in general, true. For instance, consider the proposition, "There are no elephants in this room." Can the truth of this negative statement be proven? Sure. If you know how small an elephant can be, the first task is to look around the room and locate all of the hiding places large enough to hold the smallest elephant. Suppose there is one. Go look in that place. No elephant? You've proven that there are no elephants in the room.

Now consider the statement, "There is no absolute truth." Is this true? If you answer yes, then the next question becomes, "Is it always true?" Answer yes again and you affirm that there is at least one absolute truth, thus refuting the original statement. You just proved that absolute truth exists. However, you have not proved *which other* truths are absolute—only that at least one exists. (I am reminded of an anecdote about a student who turned in a philosophy paper in which he argued that there is no right and wrong. The professor gave him an F. The student went to see the professor about it and the professor told him that, yes, it was a very well-written paper, and would surely have received an A. But the student used a green binder for the paper, and he, the professor, hated green binders and so failed the paper for that reason. The student objected that it was wrong to fail his paper for that reason. "A-ha!" said the professor. "So you admit that there really *is* right and wrong?" The point now having been made, the student got his A.)

Of course, most proof is not easy to come by, and sometimes proof is only suitable for one person at a time. For instance, I have made allusion in previous columns to the fact that I've had what can best be described as a psychic experience. The details of the situation are not particularly relevant. Suffice to say that what happened to me was both unprecedented in my life up to that time, and certainly not something I'd been either looking or hoping for. Indeed, at that time in my life I was highly skeptical of all claims of psychic episodes or psychic powers. My "psychic period" lasted about two months, and nothing like it has happened to me in the twelve years since. During that time, I was fully aware of how odd the "psychic thing" was, and I kept asking myself whether or not I was imagining things. But after a bit, I just went with the flow, and the episode ended as abruptly as it began.

There would be nothing more to say about it other than that my life changed entirely because of that episode.

Coming back to my point about proof, I am now absolutely certain that, at least in some cases, psychic events can and do happen. I am certain because one happened to me, and I know I didn't make it all up just as certainly as I know my ninth grade class trip was to Chicago, or that I had pancakes for breakfast last Sunday.

But what serves as proof for me in this instance can't serve as proof for others—it's too personal and too potentially subjective. If it does work as proof for some, then they need a booster shot of skepticism unless they too have had a psychic episode or two. (Even then, that would say nothing about whether or not *my* episode was legitimately psychic.) At best, for someone else, my story can serve as but one more piece of anecdotal evidence in favor of the hypothesis that psychic occurrences are real.

But this leads us to the crux of the matter, that being, what sort of evidence must one see to accept that a proposition has been proven? Or, in other words, what does proof look like? If you

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don't know what form proof is going to take before you go looking for it, then how will you recognize it if you find it?

This particular consideration is the most important thing I'd like my readers to realize. The point is often lost even on scientists (even though an experiment is, after all, nothing more than an attempt to bring about a result that *looks like* evidence in favor [or in refutation] of a certain hypothesis). Despite my formal academic training in science, I really came to understand this concept by reading C. S. Lewis. In Lewis' heyday, astronomers were just beginning to learn how huge the Universe was. To some religious skeptics, this was "proof" against the existence of God. Lewis found this amusing. "Oh, really?" Lewis would say. "How big, then, would the Universe be if there *was* a God?" you can imagine him asking.

In my own work on (and sometimes beyond) the frontiers of science, it is both my pleasure and my curse to meet up with scientists and inventors who are sure they've found something new. One such inventor I met (and to whom I will be merciful and not reveal his name) was convinced that he'd found a gaping hole in thermodynamics. Indeed, he was convinced he could build a heat engine that would draw power from the natural environment without the need for a temperature gradient. At the time I heard his presentation, he had not actually *done* an experiment to test out his ideas, though he had filled many notebooks with those ideas and his calculations and could prove mathematically that the thermodynamics taught in the textbooks was wrong.

Well, now, this was simple enough. It was easy to figure out what proof would look like. The claim was straightforward—"I can build a machine that will do such and so." Had such a machine been built? Nope. But there was another claim—"I can prove mathematically that. . . ." Great. Please do so.

As it turned out, the inventor proved that he didn't understand the rudiments of calculus, and he also proved that he didn't read those textbooks all that closely either, to see what it was they actually *said*. (In particular, he failed to note under what circumstances certain caveats applied to the equations presented.) However, although he was unable to prove his assertions, that all by itself doesn't make him wrong. But until he provides proof that "looks like" proof, his claims should be dismissed.

One of the now quasi-serious frontier scientific pursuits is SETI, the search for extraterrestrial intelligence. Oddly enough, this pursuit is only granted the patina of respectability when it is conducted with radio telescopes. UFO enthusiasts need not apply. Even though SETI has yet to find extraterrestrials, I think their patron saint Carl Sagan was the first to say, "The absence of evidence is not evidence of absence."

Oh, really? Then just what the hell is evidence of absence *supposed* to look like if not the failure to find signals from extraterrestrials, hmmm? It might not be proof of absence, but it most certainly is evidence of it. But if I were to make the extraordinary claim that there are no ETs, what sort of evidence could I put forth that would be suitably extraordinary enough for my claim to be taken seriously?

Just what is meant by "extraordinary?" And who gets to decide what it is?

To both questions, I answer, "I don't know." And I don't think anyone else knows, either.

What I do think is that most of the time we aren't actually interested in proof so much as proper sanction. The clerk who checks the license likely doesn't care if he's selling to a twenty rather than to a twenty-one-year-old. He just wants to make sure his butt is covered in the event that the patron is found to be a minor. And the average Joe who doesn't believe in flying saucers or ESP doesn't feel that way because no evidence has turned up. He doesn't believe it because the sanctioning authorities—i.e. "The scientists"—haven't bestowed their blessing.

If you don't believe me, just look at the evidence.■

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Arms races, by their nature, tend to escalate. But the biggest leaps aren't necessarily the most dramatic. . . .

"Hello," Said the Stick

Michael Swanwick

"Hello," said the stick.

The soldier stopped, and looked around. He did not touch the hilt of his sword, but he adjusted his stance so he could reach it quickly, if need be. But there was nothing to be seen. The moors stretched flat and empty for miles about. "Who said that?"

"I did. Down here."

"Ah. I see." The soldier poked gingerly at the stick with his foot. "Some sort of radio device, eh? I've heard of such. Where are you speaking from?"

"I'm right here. The stick. I'm from off-planet. They can make things like me there."

"Can they, now? Well that's interesting, I suppose."

"Pick me up," said the stick. "Take me with you."

"Why?"

"Because I make an excellent weapon."

"No, I mean what's in it for you?"

The stick paused. "You're smarter than you look."

"Thanks. I think."

"OK, here's the deal. I'm a symbiotic mechanism. I was designed to be totally helpless without a human partner. Pick me up, throw an acorn in the air, take a swing at it, and I can shift my weight so you hit it a country mile. Leave me here and I can't budge an inch."

"Why would they build you like that?"

"So I'd be a good and faithful tool. And I will. I'll be the best quarterstaff you ever had. Try me and see."

"How do I know you won't take over my brain?" the soldier asked suspiciously. "I've heard offworld wizards can make devices that do things like that."

"They're called technicians, not wizards. And that sort of technology is strictly prohibited on planetary surfaces. You have nothing to worry about."

"Even so . . . it's nothing I'd want to chance."

The stick sighed. "Tell me something. What's your rank? Are you a general? A field commander?"

"Tramping alone across the moors like this? Naw, I'm just a gallowglass—a mercenary and a foot soldier."

"Then what have you got to lose?"

The soldier laughed aloud. He bent to pick up the stick. Then he put it down again. Then he picked it up.

"See?"

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"Well, I don't mind telling you that takes a weight off my mind."

"I could use a change of scenery. Let's go. We can talk along the way."

The soldier resumed his stroll down the dirt track. He swung the stick lightly back and forth before him, admiring how it lopped off the heads of thistles, while deftly sidestepping the sedge-roses. "So you're off to join the Iron Duke in his siege of Port Morningstar, are you?" the stick remarked conversationally.

"How'd you know that?"

"Oh, one hears things, being a stick. Fly on the wall, and all that."

"It's an unfamiliar figure of speech, but I catch your meaning. Who do you think's going to win? The Iron Duke or the Council of Seven?"

"It's a close thing, by all accounts. But the Iron Duke has the advantage of numbers. That always counts for something. If I had to bet money, I'd say you chose employers well."

"That's good. I like being on the winning side. Less chance of dying, for one thing."

They'd progressed several miles across the moors when the Sun began to set. The soldier laid the stick aside and set a snare for supper. By the time he'd pitched a tent, made camp, and cut peat for a fire, he'd caught a rabbit. He roasted it slow and, because he had a fondness for drumsticks, ate all six legs first, along with three small bunyips, boiled with a pinch of salt from a tin. Like many an old campaigner, he ate in silence, giving the food his undivided attention.

"Well," he said when he was full and in the mood for conversation again. "What were you doing out here in the middle of this godforsaken wilderness?"

The stick had been stuck into the earth on the opposite side of the campfire, so that it stood upright. "I was dropped by a soldier," it said, "much like yourself. He was in pretty bad shape at the time. I doubt he's still alive."

The soldier frowned. "You're not exactly standard gear."

"No, I'm not. By compact, planetside wars are fought with primitive weaponry. It was found that wars were almost as environmentally destructive as the internal combustion engine. So . . ."

"Internal combustion engine?"

"Never mind. It's complicated. The point I was trying to make, though, is that the technology is there, even if it's not supposed to be used. So they cheat. Your side, the other side. Everybody cheats."

"How so?"

"That sword of yours, for example. Take it out, let's get a look at it."

He drew the sword. Firelight glimmered across its surface.

"Tungsten-ceramic-titanium alloy. Self-sharpening, never rusts. You could slam it against a granite boulder and it wouldn't break. Am I right?"

"It's a good blade. I couldn't say what it was made of."

"Trust me on this one."

"Still . . . you're a lot fancier than this old sword of mine. It can't talk, for one thing."

"It's possible," said the stick, "that the Council of Seven is, out of desperation, pushing the envelope a little, these days."

"Now *that's* a figure of speech I've neither heard before nor can comprehend."

"It means simply that it's likely they're using weapons rather more sophisticated than is strictly speaking allowed by the Covenants of Warfare. There's a lot riding on this siege. The Iron Duke has put everything he has into it. If he were defeated, then the worst the Council of Seven could expect would be sanctions and a fine. So long as they don't use tac-nukes or self-reprogramming viruses, the powers that be won't invoke their right to invade."

"Tac-nukes or self-reprogramming viruses?"

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"Again, it's complicated. But I see you're yawning. Why don't you bank the fire and turn in? Get some sleep," said the stick. "We can talk more in the morning."

But in the morning, the soldier didn't feel much like talking. He packed his gear, shouldered the stick, and set off down the road with far less vigor than he had the day before. On this, the stick did not comment.

At noon, the soldier stopped for lunch. He let his pack slip from his shoulders and leaned the stick against it. Then he rummaged within for the left-over rabbit, only to make a face and thrust it away from him. "Phaw!" he said. "I cannot remember when I felt so weak! I must be coming down with something."

"Do you think so?" the stick asked.

"Aye. And I'm nauseated, and I've got the sweats as well."

The soldier wiped his forehead with his hand. It came back bloody.

"Chort!" he swore. "What's wrong with me?"

"Radiation poisoning, I expect. I operate off a plutonium battery."

"It's . . . you . . . You *knew* this would happen to me." Unsteadily, he stood, and drew his sword. He struck at the stick with all his might. Sparks flew, but it was not damaged. Again and again he struck, until his strength was gone. His eyes filled with tears. "Oh, foul and treacherous stick, to kill a man so!"

"Is this crueler than hacking a man to death with a big knife? I don't see how. But it's not necessary for you to die."

"No?"

"No. If you grab your gear and hurry, you just might make it to the Iron Duke's camp in time. The medics there can heal you—antiradiation treatments aren't proscribed by the Protocols. And, to tell you the truth, you do more damage to the Iron Duke's cause alive and using up his personnel and resources than you do neatly dead in the moorlands. Go! Now!"

With a curse, the soldier kicked the stick as hard as he could. Then he grabbed his pack and shambled off.

It was not long before he disappeared over the horizon.

A day passed.

Then another.

A young man came trotting down the dirt track. He carried a sword and a light pack. He had the look of a mercenary.

"Hello," said the stick.■

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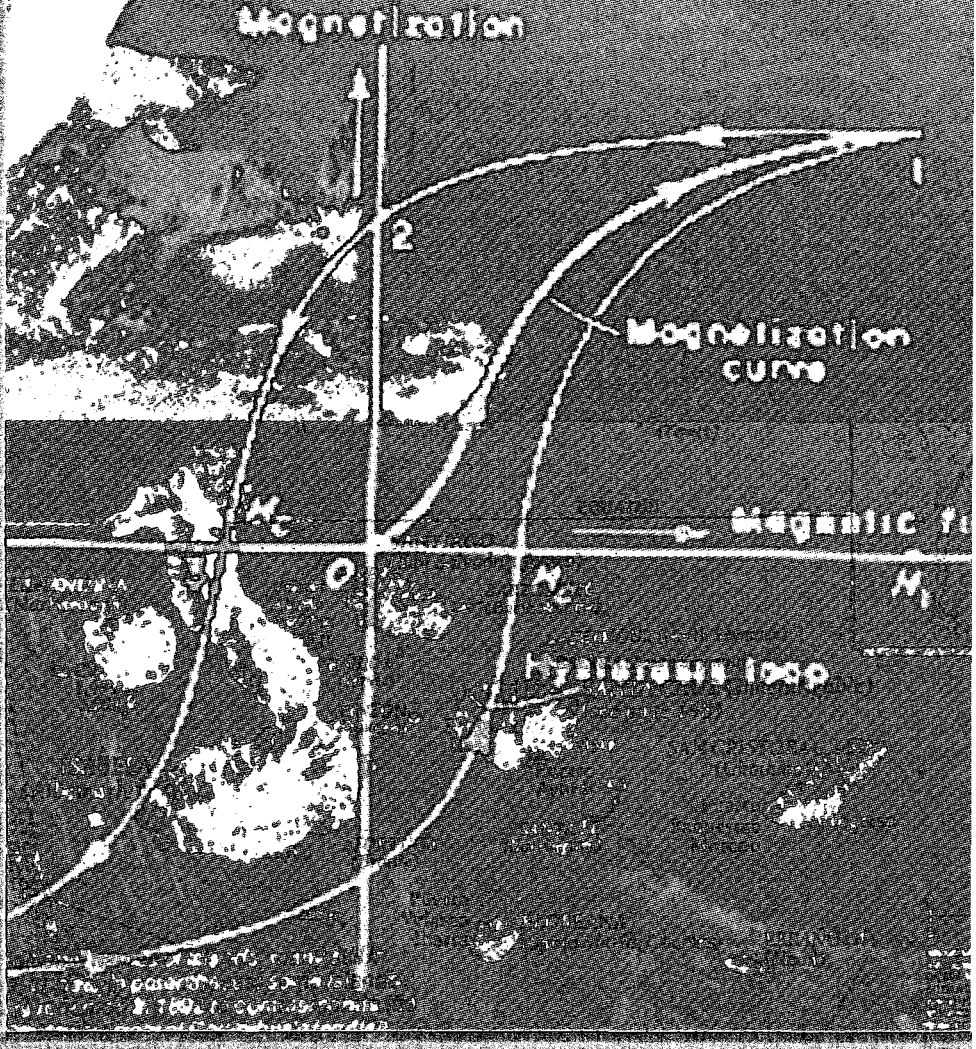
FLIGHT CORRECTION

Ken Wharton
Illustration by Broeck Steadman



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"Albatross, Daddy!" Sally's freckled face was pure excitement. "Albatross!"

Hank blinked a few times from his position in the hammock under the red mangroves. His daughter stood just beyond his reach. "How do you even know what an albatross looks like?"

"Just come quick, Daddy! C'mon . . ." She stepped forward and tugged at the remnants of his favorite shirt, a threadbare blue oxford from his professor days back in the states.

Hank finally got to his feet and followed his daughter down to the narrow lagoon. Splashing across after her, he realized he had forgotten his hat. "Wait a sec, Sally . . ."

Whether she heard him or not, she didn't turn around. *Screw it*, he thought, still following her. If he fried his bald spot in the equatorial sun, it wouldn't be the first time. Stepping out of the water, they turned left, following the main path across the white sand beach. "Where's your mother?" he asked at last.

"Finches," was all Sally said, clearly doing her best to be patient with her slow-paced father.

Of course. Those boring little critters that he'd never learned to tell apart. If his wife had studied some of these *other* birds he might actually be interested in her research. At that very moment Hank was walking right past a pair of goofy-looking masked boobies, brilliant white except for the dark mask around the yellow-orange bill. The two birds were waddling around their sorry excuse for a nest, which looked for all the world like a random pile of rocks on the ground. Meanwhile, three beautiful red-pouched frigate birds sat within reach just overhead in the mangrove tree, inflating their sacs and ululating madly. All the birds ignored the humans with their usual Galápagos detachment, which could have made them easy to study. But instead Julia went roaming all over the island in search of those damn finches.

Sally led him up the trail toward the two solar-powered lighthouses that guided those intolerable mini-cruiseships into the heart of Genovesa. After a minute of climbing, Hank was embarrassed to find himself panting with exertion. He glanced down into the blue expanse of Darwin's Bay and made a half-hearted resolution to start swimming again.

Finally Hank made it over a crest, and there it was. Standing on an ancient memorial plaque at the edge of the cliff was an enormous white bird with a hooked, yellow beak. It was, in fact, an albatross.

"Wow," muttered Hank, his interest growing despite himself. He had been told that these birds were endemic to Española, at the far south of the Galápagos archipelago. Hank had even seen them down there once, a huge breeding colony next to the cliffs. But on this island, a hundred miles to the north, he had never seen one. Not a single one, for the three years they had lived here.

"Must have gotten lost, I guess," Hank said to his daughter. "Mom'll be interested."

But Sally apparently wasn't finished yet. She was already halfway to the next crest. Hank sighed and started walking again. "What's up there? Another . . . ?"

Hank broke off as he approached the top and could see the far side of the island. There *was* another one! And another. . . . With every step his jaw dropped a little further.

Here on Genovesa, a hundred miles off course, five dozen albatross had gotten lost in the exact same place.

Hank watched from the shade under the lighthouse while Julia filmed an albatross flopping toward the edge of the cliff.

"Their feet are funny, Mommy," Sally was saying. "They're way too long."

"They're not made for walking," Julia explained. "Wait, watch this . . ."

The bird hesitated at the edge of the

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cliff, extending its six-foot wingspan once, twice, and then backing off as if it was scared to death by the prospect. After a couple more fakes, it stepped forward and jumped. Jumped, not flew. Hank saw a white form plummet out of view, then reappear, enormous wings outstretched, speeding away over the calm water.

"See, Sally," his wife was saying. "They don't really flap. Takes too much energy, so they soar instead. Dynamic soaring, it's called."

"Where's it going?" Sally asked.

"To fish, probably. Maybe around here, maybe down off the coast of Peru. Or maybe it's going back to Española, where they all live."

"But then . . . what are they doing here?"

Julia lifted her gaze from the camera, smiled at her daughter. "*Very* good question. Usually they know right where to go."

Hank spoke up. "Know any bird people down south?"

Julia nodded. "Fernando does satellite migration tracking. Probably has some tagged ones right here, actually."

"Hmm. Maybe you'll get a call from him," Hank said.

"Oh, I'm sure the birds will all be gone before sundown."

Sally looked a bit sad. "But, but . . . it was nice of them to visit, right?"

Julia beamed down at Sally. "And it was nice of you to spot them for us. Otherwise we might never have known they were here."

Ten days later, the albatross population was pushing a hundred and fifty.

The population of bird people was skyrocketing as well: Fernando's arrival this evening made four. Five, counting Julia. Their little island was getting awfully crowded. Not to mention their home.

Hank normally would have simply left, gone outside to read his new download in private, but tonight El Meaño had sent yet another nasty rainstorm. And with the birders living in tiny two-man tents, the family's semipermanent shelter was the only spot for them all to gather.

Hank couldn't imagine how Sally managed to sleep through the noise; he couldn't even read with all their chatter. And if he heard the word 'migratory' just one more time. . . . Finally, in frustration, he picked up the sim-finch he had designed for his wife's research and started morphing the beak into implausible shapes.

It was an impressive piece of machinery, Hank modestly told himself. Back in the early days of finch research, before nano'geering enabled such devices, academics had resorted to more gruesome techniques. One ancient study even reported chopping the heads off of dead birds, swapping them around with the bodies, and then setting the chimeras in seductive poses to see who would try to mate with the corpses.

"I don't think that one is going to see many suitors, honey." Julia was speaking to him from across the room, referring with her eyes to the avian Cyrano. Hank shrugged and set it back down, nearly spilling his bottle of rum. Julia turned back to the main conversation.

"I'm telling you," Julia insisted. "The albatross are getting confused by the Line."

Hank rolled his eyes and turned away. His wife was always complaining about the space elevator; nothing new there. But still, he couldn't tune out the conversation.

"I don't buy it, Julia," said the only other female in the group, a penguin expert. "One new star is not going to mess up these birds. They've done studies—"

"One star that doesn't rotate with all the others," Julia countered. "It's not natural."

"It's been fully clouded over the last few nights," noted Fernando. "And they keep arriving. So it can't be the stars."

"Well, what does that leave? Landmarks and dead reckoning?"

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Hank looked back over at the group, surprised at the obvious omission. "Don't forget magnetic fields." Even a washed-up N.E. professor knew *that* much about bird migration.

The penguin expert shook her head. "Not here at the equator. Sure, albatross have traces of magnetite in their brains like other birds, but the fields are so much weaker here that they don't rely on them at all."

Fernando stroked his white beard. "Still, he has a point. Flying up from Peru, it's a pretty small angular shift between here and Española. You know Tuttle, up in the states? He's bred a strain of pigeon that'll ignore all other cues, steer by magnetic fields alone. It must be an innate module in pigeons, so maybe all birds have it to some degree. Not at all inconceivable that new fields could gently steer the albatross off course."

"Maybe," Julia said. "Maybe that's what the Line is doing to them. Changing the fields."

"Enough about the Line, already," said Hank. Five pairs of eyes swiveled to glare at him, with varying levels of intensity. Hank retreated into his book, making an important mental note: don't mention the Line around Galápagos ecologists.

Hank supposed that the primary responsibility lay with generations of science fiction writers. If Ecuador hadn't been so *certain* about Quito they wouldn't have campaigned so heavily for a space elevator in the first place. They wouldn't have weaned two generations on the premise that Ecuador would be the gateway to orbit, finally giving their country the first-world status they deserved. Eventually, they dreamed, Ecuador would become the richest and most powerful nation-state on Earth.

So the initial site report had taken them very much by surprise. High elevations weren't recommended. Sure, altitude meant slightly less cable, but compared to the total distance to geosynch orbit, the percentages involved were so small as to be almost meaningless. Besides, in the mountains there wasn't easy access to a seaport—an essential part of the high-volume operation.

Then there was the disaster scenario. Dropped equipment, hazardous spills, broken cables snapping down onto the surface of the earth . . . A remote location was deemed necessary for safety concerns alone. Ecuador was hit hard on both fronts: everything was too mountainous or too crowded. Or both. Suddenly Brazil and Indonesia were being discussed as possible elevator locations.

For Ecuador, faced with the loss of its dreams, the sacrifice of its most famous national treasure hadn't come hard. The largest of the Galápagos islands, Isabela, was the only one to actually span the equator. If Quito wasn't possible, Ecuador had told the world, Isabela would be just perfect.

Predictably, the ecologists went daytrader on the whole idea. The Galápagos was not only a pristine ecological laboratory, but the very birthplace of evolutionary theory. They hadn't spent millions of dollars ridding Isabela of the wild goats, fighting the unending battles with the local fishermen, only to have the island turned into the biggest port on the planet. Years of intense protest followed, but the initial public opposition faded as Ecuador spared no expense on the propaganda wars. Hardly any of the islands would be affected, the government promised. The giant land tortoise population of Isabela would be protected. A portion of the future tax revenue was even allotted to environmental research to help sow dissension in the ecologists' midst.

And, as always, the money had won. The space elevator had been completed five years ago, and all of the rosy predictions were now proven rubbish. Isabela was almost completely developed, and many of the other islands were heading in the same direction. The smaller outly-

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ing islands were still relatively unaffected, but no one knew how long that would last.

To Hank, the Line had once dangled the promise of tropical employment. Three years back, when he had sacrificed his job for his family, he had held out hope of finding work on the space elevator. The entire structure was nano-engineered, after all. His specialty. And with that fantasy in mind, giving up his tenure-track position hadn't seemed quite so final.

But the reality down here had been different. The completed elevator had no need for academic types. The only jobs available were loading cargo—and Hank's back certainly couldn't handle that.

So now he was just living for his family, and the occasional bottle of rum. No more Paula, no more cheating around, no more rat race . . . no more anything. *But I'm doing the right thing,* Hank told himself, reciting his mantra. *I'm doing the right thing.*

From across the room Julia glanced in his direction, with a smile that said she still loved him despite his terribly insensitive comment about the Line. He tried to return the smile, tried to return a bit of love to his wife, but came up empty on both counts. Hank raised his book to cover his face, and buried himself in the meaningless words.

They didn't speak again until halfway through breakfast.

"Hank . . ."

He knew that voice, that look. Hank took a shallow breath and steeled himself for another painful argument.

"Why *wouldn't* you expect a magnetic field from the space elevator? Shouldn't there be currents every now and then?"

His pulse skipped a beat as he realized it wasn't going to be *that* sort of argument. He managed a smile.

"Yeah, that was a big worry. The cable goes right up through the Van Allen belts, after all. Wouldn't do to have an induced current yanking on the Line. So they spun it to be nonconducting."

"But buckytubes are . . ."

Hank broke into a full grin. Finches might be boring, but *this* stuff was cool. He arrayed his napkin in front of him, smoothed it out. "Not always. OK, say this is a single sheet of carbon atoms, arrayed like hexagonal chicken wire. You make it into a buckytube simply by rolling it up." He did so. "But there are lots of different classes of buckytubes, depending on how you line up the hexagons."

He demonstrated this by first making a cylindrical tube—with the corners of the napkins touching—and then sliding one edge of the napkin with respect to the other. Now the axis of the tube was no longer perpendicular to the bottom edge of the napkin.

"There are lots of buckytube topologies, and each one has a different conductivity. So the tubes in your computer conduct, but the tubes in the Line don't."

Julia looked skeptical. "Thousands of miles of buckytube cable and they're sure it's *all* the non-conducting kind?"

"The fibers are all continuous. If there was a transition between two buckytube geometries, there has to be a discontinuity, a weak link. The tube hasn't snapped, so I think that's a good sign."

Hank was exaggerating; a single-point failure wouldn't snap the Line. It had been given the same design as the successful multifiber space tethers, which contained many redundant strands that weren't even in use. If one strand failed, two others would instantly snap into place to take up the load.

Julia just shook her head. "I don't know, Hank. . . . But I do know that's got to be the answer. These birds think they're on Española. *Something* has messed them up, and we've dismissed pretty much every other explanation. Think about it, will you?"

"Sure, honey." Hank's gaze skipped

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over to the rum supply, then back to Julia. "Sure."

By afternoon, he wasn't thinking about much of anything. The bottle had been out of reach for awhile, but it wasn't worth the effort to get off his hammock.

How many hours had he spent in this thing? he wondered. More likely the time should be measured in months. The hammock was the fabric of spacetime, Hank decided, and he was a gravitational sink, warping the geodesics around his body. By now he knew every fiber of the netting; at that very moment he could tell that there were was a single crease running under his left buttock. He tried to mentally picture the folded topology down there—the strands in the middle doing no work at all, forcing its neighbors to pull twice their weight.

Just like the Line, he realized. Only the Line was different because . . .

Hank bolted up straight, nearly spinning the hammock and dumping him onto the sand. The topology shift didn't have to be in the primary fibers, he realized. The slack fibers could carry a current as well. And if *they* were starting to shift . . .

Five minutes later he was at his wife's computer, commencing his first literature search in nearly two years.

"So there you have it," Hank told his wife two nights later. "That's my best guess."

Julia squinted at the pencil sketches that Hank had just drawn for her, shaking her head. "I might understand the concept, but certainly not the details. What am I supposed to do with this?"

Hank shrugged, got up from the table and padded into the bathroom to get ready for bed. "I don't know what you do with it," he called over his shoulder. "That's for you to decide."

He was in the middle of brushing his teeth when he saw in the mirror that Julia was standing beside him, glaring with a fury he hadn't seen in years.

"For *me* to decide?! Me? What about *you?!*"

Hank spun to face her, his mouth full of foam. "Whmmh?"

"Do you know how glad I've been these last two days, seeing you actually do some work you enjoy? I know you're not happy here. I know these islands are sapping the life out of you. But now that you've figured out this problem you're just going to drop it? You're just going to flop right back into your hammock, back to the way things were?"

Hank spat into the sink, wiped his face with the back of his hand, and looked up to stare at his own reflection. "This was just a one-time coincidence. As soon as you report it, like it or not, things *will* be right back where they were. I'm not needed here."

"Sally needs you, you know that. Hell, if you're right about this, the whole goddamn solar system needs you."

He turned again to face her. "And you?"

"I . . ." Julia drew a breath through pursed lips. "I need my husband. But what I don't need is—"

Julia broke off as Sally appeared in the doorway, half-asleep and obviously frightened. Hank dropped to a squat and she ran into his arms.

"Were we too loud for you?" Hank asked, stroking her hair. "We're sorry, we'll be quiet."

He stood up, lifting his daughter into the air. Julia stepped over to plant a kiss on her cheek, then glanced up apologetically at Hank. He smiled at his wife, nodded, and carried Sally off to bed.

Hank ran a final check of his computer model while the dozen bird people nestled in for the presentation. He had first considered making a physical model, but the only string he could find on the island was his hammock, and he wasn't ready to sacrifice it just yet. Instead, he had had to dredge up his old

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programming skills for the proper 3-D rendering.

"Everyone ready?" he asked the crowd. Julia nodded in reply, then winked at him. Sally sat next to her mother, peeking inside a Tupperware container at her pet lava lizard, Darwin.

"OK," Hank began. "This is a molecular view of one section of the Line. The *original* design." The lattice appeared on the screen behind him, blue and red lines arrayed in a webbed cylinder.

"Each one of these lines is a single-wall buckytube, and together they form this larger cylinder called a fiber. The blue strands are the primaries, where all the strain is carried. But you'll notice that there are more secondary red tubes than blue ones. That's because if there's a point failure . . ."

Now a virtual pair of scissors appeared and snipped one of the blue strands. The fiber stretched only slightly as two red lines snapped into place to take up the slack. "Redundancy. And I'm only showing you the tubes and the fibers. These fibers are woven into what's known as a bundle, and in turn the bundles form the backbone of the Line itself. Each level of complexity has both primary and secondary strands, and the redundancy gives the Line an expected 700-year lifetime."

"Only 695 to go," muttered the penguin expert.

"Or maybe not," Hank retorted. "Which is the whole point. The redundancy assumes that the secondary fibers maintain their structure, even when they're not in use."

Now the 3-D graphics zoomed in on a spherical-fullerene intersection where two red lines crossed a blue. At this resolution the lines were no longer 1-dimensional; now each buckytube appeared as an actual cylinder, composed of a geometrical spiral of dots.

"Each one of these dots is a carbon atom," Hank explained. "And as I said, this is the *original* design. A full quantum analysis was performed on this design, to make sure that the secondary fibers wouldn't degrade, even without full tension. The entire simulation series took 19 months to run on ASCI Platinum. And *then* they changed the design."

Hank hit a button on the computer and now the spherical intersections shifted ever so slightly. "This was what they actually built, shaving ten months off construction. Very subtle change—only two carbon atoms have moved per intersection. But the orbital pattern is different enough to require an entirely new calculation.

"Now, there are public documents which *refer* to a new calculation, but nothing about it was ever published. And it only took 6 months from the design change to the final ratification. It all points to someone doing a half-assed perturbative analysis using the old design as a starting point, and passing it off as the real thing."

"I don't understand," said Fernando from the front row. "This has something to do with magnetic fields?"

Hank sighed. Apparently the nanotech details were lost on this crowd. Still, it was good practice for later.

"It's possible," Hank said, "although I can't say for sure. The concern is that the new design might be susceptible to topology shifts like this." He hit his last animation cue, and one of the secondary tubes *slipped*. The structure didn't break, but one row of carbon atoms slipped relative to another, leaving the red tube with a different spiral pattern than the others.

"This weakens the fiber, and if it happened throughout the line, might shorten its lifetime considerably. A side effect would be that these shifted tubes can become electrically conducting, and perhaps generate their own magnetic fields. And once currents start flowing through them, all the calculations are going to be way off. It might even accelerate the slipping process."

Julia spoke up. "I'm sure Hank's on to

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something. We've seen what's happening to the migration patterns."

Hank flipped off the projector as the bird people started chattering amongst themselves. Only Fernando got to his feet and approached him, a worried look on his face.

"Tell me, son. If you're right. . . . They're going to have to shut down the Line for awhile?"

"At the very least."

Fernando's old eyes sparkled mischievously. "Well, I can tell you, you'll have a lot of support from the people in this room. But you're going to have a hell of a time getting anyone on Isabela to listen to you."

"That's the nice thing about the scientific process," Hank said with a grin. "After I make the claim, the evidence will prove me right or wrong."

Fernando shook his head sadly. "I've played this game for many years, son. This isn't about evidence, or even science. Be careful."

"Don't worry, Fernando. I think I can handle this."

"I hope so," the old man replied, turning back to converse with the rest of the crowd. "I hope so."

A week later, Hank finally managed to contact an actual Tethercorp employee over the net. It was still before dawn on the Galápagos, but by now he had resorted to calling the London office.

The man on his computer screen didn't look like a scientist; probably a mid-level bureaucrat. No matter. Hank would start with this guy and work his way up the chain.

The bureaucrat held a printout of Hank's report up to the camera. "Is this yours?" he asked.

"Yes. I'm a nanotech engineer from—"

"I'm having trouble filing this one," the man interrupted. "The bulk of it looks like it should go into Harmless Crackpot, but this first paragraph reads more like a Bomb Threat. Could you clarify your position for me?"

Hank was livid, but forced himself to speak slowly and deliberately. "Could you please tell me, then, what is the proper channel for scientists to present—"

"Harmless Crackpot, then. Thank you." The picture flickered off.

"Jesus!" Hank stomped outside and stared out into Darwin's Bay. A cruise ship was heading out to sea, stirring up a brilliant wake of bioluminescence. He waited for the anger to subside, raising his gaze from the lights below to the stars above. Topside Station, gateway to the solar system, was visible directly overhead. It was brighter even than Venus. Hank's neck began to ache, but staring upwards was better than being hunched over the computer.

"You can do this," said Julia from behind him.

Hank turned around, startled. "What?" he snapped.

"You can do this. Don't give up so easily."

"I'm not giving up."

"But you're not doing what you need to do, either."

Hank clenched his fists. "I'm perfectly able to do this by myself."

"I don't get it." Julia raised her hands in confusion. "What's so terrible about contacting your old colleagues? What do you still think you're running from?"

"I didn't run. I gave up my job to be with you and Sally."

"Dammit, Hank, you're *not* going to make me feel guilty about your decision! You were the one who proved we couldn't live apart."

Hank shut up for a moment, biting off the snappy reply which came to mind. Yes, he had had an affair, but weren't they supposed to be beyond that?

"What do you want from me?" he said at last. "I'm doing science again, OK? I'm *working*. So now you're asking me to go dump the problem on Vargas' lap, let the *real* scientists solve the problem?"

Julia shook her head. "That's not the issue and you know it. You haven't con-

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tacted these people in three years. Are you afraid of them? What do you imagine they think of you?" She stepped forward to wrap her arms around him, and he didn't fight her off.

"Just that . . ." he began. "Just that I washed out, couldn't handle the job. I think Vargas is the only one who really knew why I left."

"Then show them what you're capable of. Show them what you've found. If they really think you're a shabby scientist, then prove them wrong."

"It's not that easy."

"Isn't it?"

They held each other, silently, as dawn crept into the sky.

In the end, Hank had resorted to an old-fashioned email.

An actual conversation would have been too awkward, he decided, but writing a letter hadn't been as painful as he'd thought. He'd picked the two colleagues who had been closest to him—not counting Vargas, of course—and sent them each a three-page summary of his findings. And now, only 24 hours later, he was startled to have already received a reply.

Hank; good to hear from you. How are Sally and Julia? Finally became a mother myself last year—twin girls; see the pics.

Interesting problem you've run across. I don't know any Tethercorp techs personally, but I think Vargas does. Mind if I ask him? I know you two didn't part on the best of terms, so let me know.

Still, no one will authorize a serious theory effort unless you come up with some decent evidence. Bird migration? Don't think that will fly around here, so to speak. Can't they measure the Line conductivity from the base station?

Let me know if you come up with some real proof. I'll see what I can do in the meanwhile.

—Abby

* * *

Moments later Hank was banging out a quick response, warning Abby not to bring Vargas into this. But he paused before sending it, thought for a few minutes, and finally erased the request.

Perhaps it was time. After what had happened, he knew that Luis Vargas would prefer never to hear from his traitorous friend ever again. But Julia was right; it was time to stop running. Yes, it would probably be better to contact Luis directly. But it would be hard. And it would be so easy to just let events take their course, to let Abby make contact for him.

Julia had been able to put the affair behind her. Hopefully Luis and Paula had done the same, had been able to move on with their lives.

There was even the outside chance that Luis didn't hate him quite so much as he deserved to.

"You seem frustrated," said Julia.

Hank sat up straight, startled by the interruption. "That's an understatement." He glanced back down at the computer screen. "I can't figure out how to measure it. Not for less than ten million, anyway. If only we could afford a fleet of custom microcopters."

"How to measure the magnetic field, you mean? Too bad it's not a biology problem, or we could use my extra grant money. Still, it can't be *that* hard to pull off. After all, the albatross figured it out."

Hank snickered. "The goddamn albatross. If only that were enough evidence. . . . I'm realizing that we hard scientists don't give animals a lot of credit."

"Maybe if they came down to Genovesa, saw the birds for themselves—"

"No," said Hank. "It doesn't mean anything to them. They want to see hard data, not birds."

Julia frowned. "But birds *are* hard data."

"Not to an engineer, darling."

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"Hmmpf."

Hank returned his attention to the screen, which was currently displaying an image of Base Station, where the Line lifted its cargo off the Earth's surface. It was situated at the saddle point on a east-west ridge connecting Mt. Wolf and Mt. Ecuador, overlooking the ocean to the north and the south. The area surrounding the Station was covered with metal warehouses, transformers, and power cables, which meant that a ground-based measurement of the B-field would be worse than useless. He had to get up off the ground, away from all other possible currents. Against that requirement he had to contend with a strictly enforced no-fly zone within a 50 km radius of the Line, not to mention his shoestring budget.

"Julia, just how am I going to get my hands on safe, cheap, airborne magnetic field detectors? I need dozens, more likely thousands, if we want to take a temporal snapshot."

After a moment of silence, Julia burst into laughter. "These islands are filled with exactly what you need! Too bad you engineers don't trust them . . ." She laughed some more.

Hank turned to look at her again. "What? Birds?"

"You said it. Safe, cheap, airborne, magnetic field detectors."

Hank started to laugh himself, but quickly grew serious again. What was it that Fernando had said the other night? Something about . . .

He shot to his feet, grabbed his surprised wife by the shoulders and planted a kiss directly onto her lips. "Julia, my dear. You are a genius."

"If you think I'm going to kiss you back before you tell me what you're thinking . . ."

Hank smiled. "I think this idea's worth more than a kiss."

"Well, then . . ." She gazed at him mischievously for a moment, and then grabbed his hands and led Hank toward the bedroom. "It had better be good," she said.

It was.

The high-rises of Puerto Villamil shimmered beyond the scorched tarmac. Hank felt Julia clasp his hand tightly as the passenger jet slowed to a halt and they waited for the passengers to disembark.

Hank recognized Abby first, followed by Jackson and Nigel. The three of them had agreed to come down to Isabela to see the demonstration for themselves.

They had already cleared customs in Guayaquil, and the once-enforced agricultural inspection had been abandoned years ago, so there was almost no delay. Hank and Julia met them on the tarmac.

The greetings had just begun when another familiar face appeared in the crowd of arrivals. Hank forced himself to keep smiling when the recognition flooded through him. It was Luis Vargas.

Luis wasn't smiling himself. He nodded briskly to Hank and Julia, then turned to introduce the two men who flanked him.

"Robert, Ali," said Luis. "Please meet Hank Sadler. And this is his wife, Julia." Luis nodded to them again. "Nice to see you both together. Robert and Ali here work for Tethercorp."

"Nice to meet you," said Hank, shaking hands. He turned to Luis, trying not to show his nervousness. "It's good to see you again. I'm glad you came."

Luis nodded a third time, then walked past him to join the others. Julia and Hank raised eyebrows at each other before turning to follow.

Puerto Villamil sat on the southern edge of Isabela, sixty-some miles below the equator. Sporting the only airport on the island, it hosted the largest population in the Galápagos, even beating out Base City up at the northern port.

The chartered van was waiting in its assigned spot, and the eight of them piled in with minimal conversation. Hank found himself sitting in the front row, directly in front of Luis, which he

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found somewhat disconcerting.

"How's traffic today?" Julia asked the driver. He responded in Spanish, and the two of them commenced to hold an unintelligible conversation. The interaction didn't seem to slow his driving, though; within minutes they were on the tollway, zooming up the eastern side of the island.

After an uneventful half-hour, the tollway cut west across the Perry Isthmus, just south of Mt. Darwin. Hank wondered what the mountain's namesake would think of the island if he could see it now. Only five weeks of the Beagle's five-year journey had been spent in the Galápagos, but Isabela had been one of the islands visited. Today, few endemic species remained. Mt. Darwin was covered with invasive California sage scrub, and the foothills beyond the tollway fence were littered with the detritus of civilization: bars, fuel cell stations, minimalls, strip clubs, and miles upon miles of warehouses and storage space.

Hank removed his gaze from the window as he became aware of an uncomfortable lull in the small talk. Up until now, Julia had carried the conversation with the other passengers, restricting her questions to general pleasantries and gently touching on the outlines of everyone's life for the last three years. But she hadn't really spoken with Luis Vargas. Now she swiveled around in her seat to face him, and Hank held his breath, hoping she would keep things civil.

"And how have *you* been, Luis? How's Paula?"

Hank's eyes bulged, but he didn't move a muscle, didn't turn to look at either of them. Why would she say something like that? Was she just trying to prove that she had moved beyond the affair? Or was she trying to evoke an outburst from Luis? Either way, she should have known better than to bring up Paula.

"We're divorced, actually," came Luis' reply.

An ominous silence passed before Julia spoke. "I'm sorry to hear that."

"Ah," said Luis, "it was probably all for the best."

Hank's mind spun, but his body remained planted. The affair had triggered a divorce? He suddenly needed to know more. How soon had it ended? Where had Paula gone? What feelings must Luis have for him after Hank had so thoroughly ruined his life?

Finally Hank turned and locked eyes with his old friend. Luis looked almost relaxed. Almost.

"I'm really sorry to hear that, too," Hank heard himself say.

Luis didn't break eye contact. "It was all for the best," he said again.

Hank turned back to the front and gratefully heard Julia bring up a new topic: the now-extirpated giant tortoise population of Isabela.

All for the best? Luis had been devastated by the news, by the betrayal. Was this just a show of bravado in front of everyone else? Or had Luis really managed to convince himself that he didn't love Paula after all?

Lost in his thoughts, Hank didn't speak for the remainder of the journey.

The Line scarred the sky like a rent in the space-time fabric. Hank stared upward through the glass ceiling of the observation deck, but no cars were visible. The Line just hung above them, motionless.

The two Tethercorp employees were busy introducing themselves to the Base Station staff. Hank got the distinct impression that these two—what were their names again?—were not exactly upper-level managers at Tethercorp. It appeared that neither of them had ever been Up.

"Um . . . I don't know," said the Tethercorp employee who might have been named Ali. He then turned to Hank. "Dr. Sadler? What exactly *are* we doing here?"

Hank checked his watch. *Just one more minute.* Julia had already made

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the call on her handheld; everything was set.

"I'm sure that Luis," Hank said, nodding at his old colleague, "has already given you the outline. If the Line were generating a magnetic field—"

"I assure you, that is quite impossible," interrupted Ali.

Hank forged onward. "Impossible or not, if it *were* generating a field, that would imply currents. Which would in turn imply—"

"That you boys could be in trouble," finished Julia.

The second Tethercorp employee turned to Luis, looking bored. "You *assured* us, Luis—"

Vargas held up his hand. "Yes, I was told that this would not be a purely theoretical argument, that some sort of experimental demonstration would make this worth your time. And I imagine . . ." He cocked an eyebrow at Hank. "I imagine that now would be a good time to show us what you've got."

"As a matter of fact," said Hank, "it is *exactly* time." He took a deep breath. "About five seconds ago—"

He was cut off by several loud beeps throughout the room. It took him a moment to realize they were sounding from the belts of the Base Station staff. The shortest man grabbed his handheld, jabbed at it, and a voice came out of the speaker.

"We have some activity out at warehouse 194. Sounded like some sort of explosion, and now we're getting reports of all these . . ." The voice broke into digital static.

"How far is that from the Line?" Ali snapped. The staff ignored him.

The short man spoke to his handheld. "Repeat that. Do we need fire containment?"

"Negative, no fire reported. Just a whole shitload of birds."

At that moment, through the glass of the observation deck, Hank saw the fluttering of the homing pigeons. Hundreds, no, thousands of birds. They glittered in the Sun; each pigeon carried a Mylar streamer for visibility.

Julia's grant money had paid for the older generations of Tuttle's pigeon-breeding experiment to be sent down to Isabela. These birds apparently didn't follow field lines quite as well as the newest generation, but they would hopefully be sufficient.

Hopefully. But Hank could already tell the plan was failing. Instead of moving as a group, the pigeons were spreading out, some flying towards the Line but some away from it. He felt his heart drop. Pigeons trained to follow magnetic fields? What had he been thinking?

"I'm worried," said Julia beside him. But she wasn't even looking out the glass. "Are we sure they're all sterilized? I know it's a little late to be worried about introducing species, but . . ."

"Sadler?" barked Ali's voice from behind. "Is this your doing? What *are* all those things?"

Julia beat him to an answer, and Hank wandered away to the opposite side of the observation deck as his wife started to explain about the pigeon's specialized navigation behavior. Hank didn't want to hear it, didn't want to stand there and be stood up by a bunch of damn birds. Right now he just wanted to be alone.

"Interesting stunt," said a voice behind him, and Hank looked up to see that Luis had followed him across the deck. "Can't imagine you thought it would work, but . . . interesting. You should have called me. We could have set up some microgliders, maybe, taken some real measurements—"

"Why are you trying to help me?" Hank broke in. "Why come down here with these two? I mean, don't get me wrong, I appreciate it. I just don't understand why . . ."

Hank trailed off and Luis watched him for a moment before he spoke. "It's been three years, Hank. Two and a half without Paula. And I'm happy. Happier than ever. You were just a symptom, not the cause."

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"But if I hadn't—"

"Then it would have been somebody else, down the line. Maybe when we had kids of our own, god forbid. I can't say that all the anger's gone. I can't even say I forgive you. But you didn't ruin my life."

"I'm glad, but still . . ." Hank turned away, looked out the window at the clear Pacific ocean. "I think I ruined mine."

Luis sighed. "You ever imagine coming back?"

"That's not an option."

"What about an adjunct position. . . ?" Luis started, but broke off when the murmurs reached them from the other side of the deck.

Hank glanced over and saw that most of the pigeons had landed or dispersed. Only a few hundred were still circling. He started to turn away again before he did a double-take. Circling?

With ten long strides he rejoined his wife and the others, wrapped his arm around Julia as he watched the beautiful fluttering Mylar.

"It only worked for the highest birds," Julia whispered to him, as if a louder voice would break the spell.

About 50 meters off the ground, a group of pigeons was orbiting the Line in a formation shaped like a diamond ring. They had found a closed-loop magnetic field. There was no other explanation; the current had to be running right through the center.

"I'm telling you, that's impossible," Ali was saying.

The second Tethercorp employee stepped between Hank and the glass, a serious expression on his face. "This is bad," he said simply.

"Yes, it is . . ." Hank searched the man's badge for the name. "Robert."

"You think it's in the secondaries?" Robert asked.

"Where else? It'll be an extraordinary effort to fix the thing, but I've been sketching out some ideas."

Robert looked him up and down. "How long have you been working on this?"

"Two months."

Suddenly Ali was forcing himself between the two of them. "Bob. Maybe they trained the pigeons to fly in circles?"

Robert ignored him, gently pushed Ali aside. He looked Hank in the eye. "Would you be interested in a position with Tethercorp? I can arrange to waive the usual interview . . ."

Julia gazed up at Hank, keeping her face impassive but letting her eyes do the smiling. He returned the look for a long moment before responding.

"No, thanks," he said, still watching his wife.

Now Julia's eyes squinted. "Hank, dear—" she began.

"But I do consulting work." He looked up at Robert. "Based right here in the Galápagos."

"Excellent," said Robert, whipping out his handheld. "Now if you'll excuse me, I have to make quite a few calls . . ."

Hank took Julia's hand in his own and looked out to see the pigeons again. Only about ten birds were remaining—this time orbiting in the opposite direction for some reason. He filed the fact away to think about later, pulled his wife toward him, and leaned down to whisper in her ear. "I'll have to spend a lot of time here on Isabela."

"It's not so far," she said, squeezing him back. "I'm happy for you."

"Hmm. I'm still nervous as hell."

"What for? You did it!"

"*We* did it. But . . . I really don't know if I'm ready for this life."

Julia commanded his full attention. "You'll never know until you try. And the alternative is—"

"Don't worry, love," Hank said, gazing out over the ocean. Three magnificent frigate birds were soaring far above the pigeons, far beyond the Line. "I don't really know where I was all these years," he said. "But I do know I'm not going back." ■

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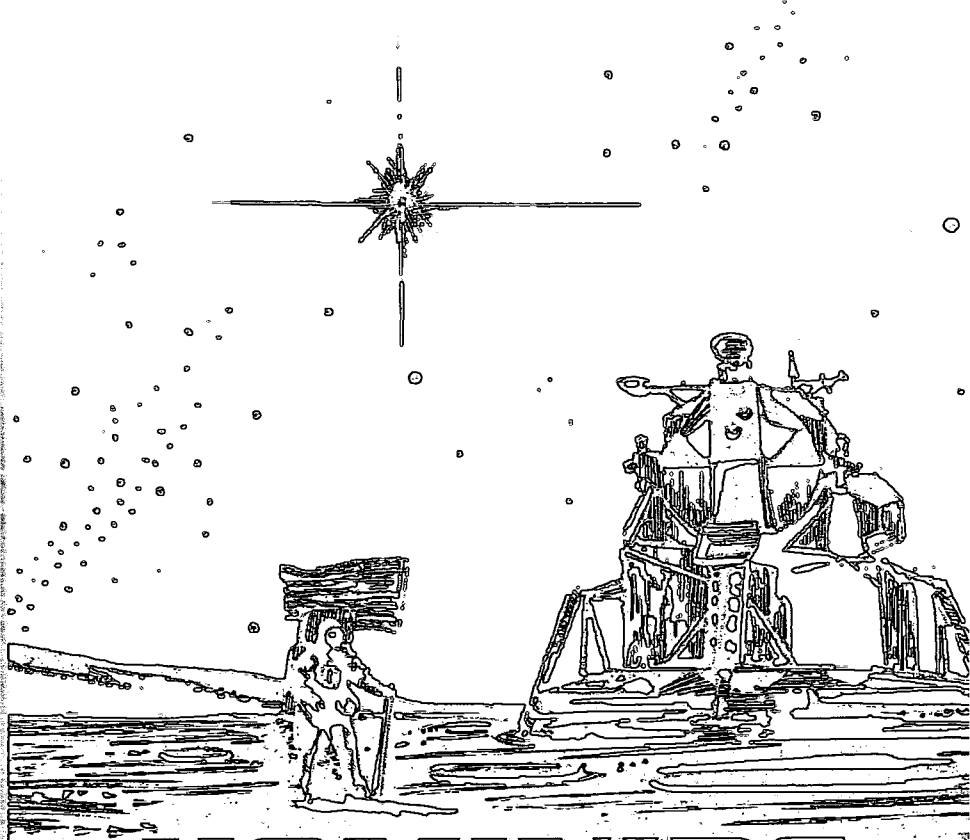

HOMINIDS

part III of IV

Robert J. Sawyer

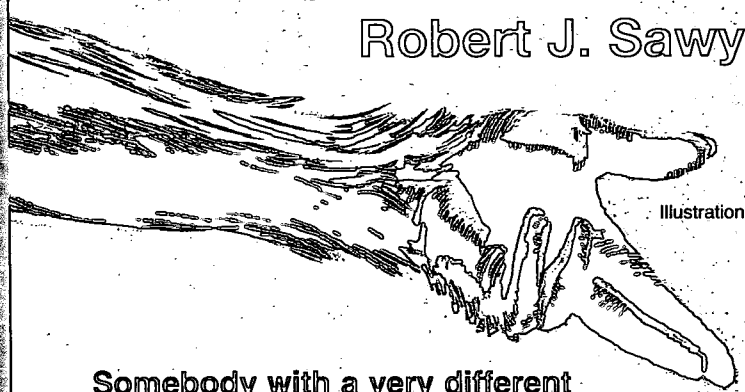

Illustration by Vincent DiFate

Somebody with a very different background can act as a new kind of mirror—and reflections are not always flattering.

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The present day. ***Ponter Boddit*** *and* ***Adikor Huld*** *are male quantum-computing researchers living on a parallel version of Earth, where Neanderthals survived to the present day and our kind of Homo sapiens did not. While attempting to factor an enormously large number, a portal opens between their timeline and ours, and Ponter, as well as all the air in the quantum-computing chamber, is transferred here.*

Ponter and Adikor's lab had been built in a unique location: 2 kilometers beneath the surface, in their world's deepest nickel mine, where their sensitive equipment would be shielded from cosmic rays. For similar reasons, in this version of Earth a physics facility exists at the same subterranean location, in what we call northern Ontario: the Sudbury Neutrino Observatory. SNO consists of a giant acrylic sphere filled with heavy water suspended in a six-story-tall chamber full of regular water. The arrival of all the air transferred with Ponter bursts the sphere apart.

Ponter almost drowns in the neutrino detector, but he is rescued by ***Louise Benoît****, a postdoctoral physics student from Montreal. Ponter is taken by ambulance to hospital, accompanied by* ***Reuben Montego****, the mine-site physician. There, an astonished doctor with a degree in osteology identifies Ponter as being a Neanderthal, based on his cranial morphology—although how he could possibly have come to be here, no one yet knows.*

Meanwhile, ***Mary Vaughan****, a geneticist who specializes in recovering DNA from ancient specimens, is raped on the campus of Toronto's York University, where she works. She makes her way home and finds a message waiting from Dr. Montego: he wants her to fly up to Sudbury to authenticate a Neanderthal specimen found there "in remarkable condition." Mary, still devastated by the rape, reluctantly agrees to go.*

Ponter, like all modern Neanderthals, has a Companion implant embedded in the skin of his forearm. His is a sophisticated model with significant intelligence; it goes by the name of ***Hak****. Although Ponter is severely disoriented by what has happened to him, Hak manages to figure out where they are, and even begins to learn some English.*

Back in the Neanderthal world, in which males and females live mostly separate lives, Adikor, who was Ponter's partner in life as well as his research partner, is stunned to be charged with murder. The disappearance of Ponter has suggested foul play, at least to ***Daklar Bolbay****. Bolbay, a female, had lived with the recently deceased* ***Klast****, another female; Bolbay had been Klast's woman-mate. But Klast had also had a man-mate, a male she consorted with when Two became One, the four days out of each month during which male and female Neanderthals come together. Her man-mate had been Ponter, and she had had two daughters by him, of whom Bolbay is now legal guardian. And on their behalf, she has put forward the charge that Adikor has murdered their father.*

Despite it being "Last Five"—the final five days of a lunar month, during which female Neanderthals, all of whose menstrual cycles are synchronized, suffer from PMS, Adikor goes into the Center, the female-occupied territory. He entreats ***Jasmel Ket****, Ponter's elder daughter, to speak on his behalf at the preliminary murder trial. If the charge against him is substantiated, Adikor, and everyone who shares 50% of his genetic material, will be sterilized in order to remove the murderous genes from the Neanderthal gene pool.*

Adikor explains to ***Lurt****, his own woman-mate, why he has chosen Jasmel to speak on his behalf. Lurt, a chemist, agrees with Adikor's choice, and promises to render any assistance she can.*

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Adikor has at least an inkling of what has really happened to Ponter, and he and Jasmel head back to the nickel mine to attempt to replicate the factoring experiment, in hopes of retrieving him.

But when they arrive at the elevator that leads down to the quantum-computing lab, Adikor is confronted by an Enforcer. When Daklar's charge against Adikor was filed, Adikor was placed under "judicial scrutiny." Companion implants transmit everything they see to the central "Alibi Archives." But the 2 kilometers of rock overhead would cut off Adikor's Companion transmissions if he went down to the lab, and so the Enforcer won't allow him to do so. It seems that Adikor will have to get the judicial scrutiny lifted before he'll be able to try to retrieve his beloved Ponter.

Mary Vaughan, who had recovered DNA from the original Neanderthal fossil several years before, meets Ponter in the Sudbury hospital and takes samples of his DNA. She transports the specimens to Laurentian University in Sudbury, and, using the genetics lab there, sets about duplicating Ponter's DNA through the polymerase chain reaction (PCR).

While the duplication is occurring, Mary goes to the Laurentian University rape crisis center; after all, she has much more anonymity here than back down south in Toronto.

Hak, Ponter's Companion implant, has identified the strange humanlike creatures populating this world as Gliksins: a form of humanity long extinct on Ponter's world. Since there's nothing wrong with Ponter, Dr. Montego sneaks him past the journalists prowling around the hospital, and takes Ponter, and Louise Benoît, out to his country home. Hak is getting better at understanding English, and Louise manages to determine that Ponter is a quantum physicist.

Mary completes her study of Ponter's DNA: he really is a Neanderthal. She joins Dr. Montego and Louise for a barbecue dinner at Montego's house, but Ponter takes ill there, collapsing. Dr. Montego makes an emergency call to Health Canada's Laboratory Centre for Disease Control.

The preliminary hearing of the murder charge against Adikor begins. Daklar Bolbay outlines her case, pointing out that Adikor contrived a situation in which the transmissions from his and Ponter's Companion implants could not be received by the alibi archives. This, she says, gave Adikor, whom she believes was jealous of Ponter's greater scientific stature, the perfect opportunity to commit murder.

Daklar then shows recordings that were made of transmissions from Ponter's Companion implant 19 years previously, when Ponter and Adikor were students together at the Science Academy. During an argument, Adikor, who has a history of trouble controlling his temper but who has since been receiving treatment for that, smashes Ponter in the face with his fist—and when a Neanderthal does that, with all his strength behind it, the blow can easily be fatal. Ponter narrowly survives.

Adikor protests that this is unfair evidence to introduce: Ponter forgave Adikor and never pressed charges against him, and so, under Neanderthal law, no crime was committed. But Daklar contends that Adikor's past violence against Ponter establishes an excellent circumstantial murder case, and says the matter should be sent on to a full trial.

Chapter 25

Mary went to the front window of Reuben's house and looked outside. Even though it was after 6:00 P.M., there would still be light for another couple of hours at this time of year, and—

Good God! The producer for Discovery Channel wasn't the only one who

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had figured out where they were. Two TV vans with microwave antennas on their roofs, and three cars decorated with radio-station logos were outside as well, plus a beat-up Honda with one fender a different color than the rest of the car; it presumably belonged to a print journalist. Once the wire-service piece had gone out about her authenticating Ponter's DNA, apparently everyone had started taking this seemingly impossible story seriously.

Reuben finally got off the phone. Mary turned to look at him.

"I'm not really set up for guests," said the doctor, "but . . ."

"What?" said Louise, surprised.

But Mary had already figured it out. "We're not going anywhere, are we?" she said.

Reuben shook his head. "The LCDC has ordered a quarantine on this building. Nobody goes in or out."

"For how long?" said Louise, her brown eyes wide.

"That's up to the government," replied Reuben. "Several days, at least."

"Days!" exclaimed Louise. "But . . . but . . ."

Reuben spread his hands. "I'm sorry, but there's no telling what's floating around in Ponter's bloodstream."

"What was it that wiped out the Aztecs?" asked Mary.

"Smallpox, mostly," said Reuben.

"But smallpox . . ." said Louise. "If he had that, shouldn't he have lesions on his face?"

"Those come two days after the onset of fever," said Reuben.

"But, anyway," said Louise, "smallpox has been eradicated."

"In this universe, yes," said Mary. "And so we don't vaccinate for it anymore. But it's possible—"

Louise nodded, getting it. "It's possible it hasn't been wiped out in *his* Universe."

"Exactly," said Reuben. "And, even if it has been, there could be countless pathogens that have evolved in his world that we have no immunity to."

Louise took a deep breath, presumably trying to stay calm. "But I feel fine," she said.

"So do I," said Reuben. "Mary?"

"Fine, yes."

Reuben shook his head. "We can't take any chances, though. They've got samples of Ponter's blood over at St. Joseph's; the woman I'm dealing with at the LCDC says she'll speak to their head of pathology, and run smears for everything they can think of."

"Do we have enough food?" asked Louise.

"No," said Reuben. "But they'll bring us more, and—"

Ding-dong!

"Oh, Kee-ryst!" said Reuben.

"There's somebody at the door!" declared Louise, looking out the front window.

"A reporter," said Mary, seeing the man.

Reuben ran upstairs. For half a second, Mary thought he was going to get a shotgun, but then she heard him shouting, presumably through a window he'd opened up there. "Go away! This house is quarantined!"

Mary saw the reporter step back a few paces and tip his head up, looking at Reuben. "I'd like to ask you a few questions, Dr. Montego," he called.

"Go away!" Reuben shouted back. "The Neanderthal is sick, and this place has been quarantined by the order of Health Canada." Mary became aware of more vehicles arriving on the country road, and red and yellow lights starting to sweep across the scene.

"Come on, Doctor," the reporter replied. "Just a few questions."

"I'm serious," Reuben called. "We are containing an infectious disease here."

"I understand Professor Vaughan is in there, as well," shouted the reporter. "Can she comment on the Neanderthal's DNA?"

"Go away! For God's sake, man, go away!"

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"Professor Vaughan, are you in there? Stan Tinbergen, *Sudbury Star*. I'd like—"

"Mon dieu!" exclaimed Louise, pointing out toward the street. "That man has a rifle!"

Mary looked where Louise was pointing. There was indeed someone there, aiming a long gun right at the house from maybe thirty meters away. A second later, a man standing next to him raised a megaphone to his mouth. *"This is the RCMP,"* said the man's amplified, reverberating voice. *"Move away from the house."*

Tinbergen turned around. "This is private property," he shouted back. "No one has committed a crime, and—"

"MOVE AWAY," bellowed the Mountie, who was clad in plain clothes, although Mary saw that his white car was indeed marked with the letters RCMP and the French equivalent, GRC.

"If Dr. Montego or Professor Vaughan will just answer a few questions," said Tinbergen, "I'll—"

"Last warning!" said the Mountie through the bullhorn. "My partner will try to only wound you, but . . ."

Tinbergen obviously wanted his story. "I've got a right to ask questions!"

"Five seconds," thundered the RCMP officer's voice.

Tinbergen stood his ground.

"Four!"

"The public has a right to know!" the reporter shouted.

"Three!"

Tinbergen turned around again, apparently determined to get in at least one question. "Dr. Montego," he shouted, looking up, "does this disease pose any risk to the public?"

"Two!"

"I'll answer all your questions," Reuben shouted back. "But not like this. Move away!"

"ONE!"

Tinbergen swiveled around, holding his hands up at mid-chest height. "All right already!" He began walking slowly away from the house.

No sooner had the reporter reached the far end of the driveway that the telephone rang inside Reuben's house. Mary moved across the living room and picked up the teal one-piece, but Reuben must have already answered on an extension upstairs. "Dr. Montego," she heard a man's voice say, "this is Inspector Matthews, RCMP."

Normally, Mary would have put down the phone, but she was dying of curiosity.

"Hello, Inspector," said Reuben's voice.

"Doctor, we've been asked by Health Canada to render any assistance you might require." The man's voice sounded thin; Mary presumed he was calling from a cellular phone. She craned her neck to see out the front window; the man who'd been using the bullhorn earlier was indeed now standing next to his white car and talking into a cell phone. "How many people are inside your house?"

"Four," said Reuben. "Myself, the Neanderthal, and two women: Professor Mary Vaughan from York University, and Louise Benoît, a physics postdoctoral student associated with the Sudbury Neutrino Observatory."

"I understand one of them is sick," said Matthews.

"Yes, the Neanderthal. He's running a high fever."

"Let me give you my cell-phone number," said the Mountie. He read off a string of digits.

"Got it," said Reuben.

"I'm going to be out here until my relief arrives at twenty-three hundred," said Matthews. "The relief will be on the same phone; call if you need anything."

"I need antibiotics for Ponter. Penicillin, erythromycin—a slew of others."

"Do you have email access in there?" asked Matthews.

"Yes."

"Do up the list. Send it to Robert Matthews—two T's—at rcmp-grc.gc.ca. Got that?"

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"Yes," said Reuben. "I'll need those as soon as humanly possible."

"We'll get them here tonight, if they are things a regular pharmacy or St. Joseph's will have on hand."

"We're going to need more food, too," said Reuben.

"We'll get you whatever you want. Email me a list of food, toiletries, clothes, whatever you need."

"Great," said Reuben. "And I should collect blood samples from all of us, and have you get them over to St. Joseph's and other labs."

"Fine," said Matthews.

They agreed to immediately call each other if there were any changes in circumstances, and Reuben clicked off. Mary heard him coming down the stairs.

"Well?" said Louise—giving away that Mary had been listening, Mary thought, by looking in equal turns at her and at Reuben.

Reuben summarized the call, then: "I'm sorry about this; I really am."

"What about the others?" said Mary. "The other people who were exposed to Ponter?"

Reuben nodded. "I'll get Inspector Matthews to have the RCMP round them up; they'll probably quarantine them at St. Joseph's rather than here." He went into the kitchen, and returned with a pad and a stubby pencil that looked like they were normally used for recording shopping lists. "All right, who else was exposed to Ponter?"

"A grad student who was working with me," said Louise. "Paul Kiriyama."

"Dr. Mah, of course," said Mary, "and—my God—she's already on her way back to Ottawa. We better stop her from meeting with the Prime Minister tonight!"

"There were also a bunch of people from St. Joseph's," said Reuben. "Ambulance attendants, Dr. Singh, a radiologist, nurses . . ."

They continued to draw up the list.

Ponter was still lying on Reuben's champagne-colored carpet through all this. He seemed to be unconscious now; Mary could see his massive chest rising and falling. His sloped brow was still slick with sweat, and his eyes were moving beneath their lids, subterranean animals at the bottoms of burrows.

"All right," said Reuben. "I think that's everyone." He looked at Mary, then at Louise, then at the ailing Ponter. "I've got to write up a list of drugs I need to treat Ponter. If we're lucky . . ."

Mary nodded, and looked at Ponter, too. *If we're lucky,* she thought, *none of us are going to die.*

Chapter 26

DAY FOUR
Monday, August 5
148/118/27

NEWS SEARCH
Keyword(s): *Neanderthal*

"Did Ponter Boddit gain legal entry into Canada? That question continues to bother immigration experts at home and abroad. Our guest tonight is Professor Simon Cohen, who teaches citizenship law at McGill University in Montreal . . ."

Top Ten reasons why we know that Ponter Boddit must be a real Neanderthal . . .

- Number ten: When he met his first human female, hit her with a club and dragged her away by her hair.
- Number nine: Mistaken in dim light for Leonid Brezhnev.
- Number eight: When Arnold Schwarzenegger dropped by for a visit, Boddit said, "Who's the scrawny kid?"
- Number seven: Watches nothing but Fox.
- Number six: McDonald's sign now says, "Billions and billions of *Homo sapiens* served—plus one Neanderthal."
- Number five: Called Tom Arnold "a hunk."
- Number four: When shown rare

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rock specimen at the Smithsonian, chipped it into a perfect spearhead.

• Number three: Wears Fossil watch and drinks Really, Really, Really Old Milwaukee.

• Number two: Now collecting royalties on fire.

• And the number-one reason we know that Ponter Boddit must be a Neanderthal? Hairy cheeks—all four of them.

John Pearce, director of international acquisitions for Random House Canada, has offered Ponter Boddit the largest advance in Canadian publishing history for world rights to his authorized biography, reports the trade journal *Quill & Quire* . . .

The Pentagon is rumored to be interested in speaking with Ponter Boddit. The military implications of the way in which he supposedly arrived here have caught the attention of at least one five-star general . . .

Now, thought Adikor Huld, as he took his seat on the stool in the Council chamber, *we'll see if I've made the biggest mistake of my life.*

"Who speaks on behalf of the accused?" asked Adjudicator Sard.

Nobody moved. Adikor's heart jumped. Had Jasmel Ket decided to forsake him? After all, who could blame her? She'd seen yesterday with her own eyes that once—granted, a long time ago—Adikor had apparently tried to kill her father.

The room was quiet, although one of the spectators, presumably making the same assumption Bolbay had earlier, let out a short, derisive laugh: *no one* was going to speak on behalf of Adikor.

But then, at last, Jasmel did rise to her feet. "I do," she said. "I speak for Adikor Huld."

There were gasps from many in the audience.

Daklar Bolbay, who was sitting on the sidelines, rose as well, her face agog. "Adjudicator, this isn't right. The girl is one of the accusers."

Adjudicator Sard tipped her wrinkled head forward, looking out at Jasmel from under her browridge. "Is this true?"

"No," said Jasmel. "Daklar Bolbay was my mother's woman-mate; she was appointed my *tabant* when my mother died. But I have now seen 250 moons, and I claim the rights of majority."

"You're a 147?" asked Sard.

"Yes, Adjudicator."

Sard turned to Bolbay, who was still standing. "All 147s gained personal responsibility two months ago. Unless you are contending that your ward is mentally incompetent, your guardianship of her ended automatically. Is she, in fact, mentally incompetent?"

Bolbay was seething. She opened her mouth, clearly to make a remark, but thought better of it. She looked down and said, "No, Adjudicator."

"All right, then," said Sard. "Take your seat, Daklar Bolbay."

"Thank you, Adjudicator," said Jasmel. "Now, if I may—"

"Just a moment, 147," said Sard. "It would have been polite to tell your *tabant* that you were going to oppose her case."

Adikor understood why Jasmel had remained silent. Had she forewarned Bolbay, Bolbay would have done everything she could to dissuade her. But Jasmel had her father's charm. "You speak wisely, Adjudicator. I shall keep your advice behind my browridge."

Sard nodded, satisfied, and motioned for Jasmel to proceed.

Jasmel walked into the center of the chamber. "Adjudicator Sard, you've heard much innuendo from Daklar Bolbay. Innuendo, and baseless attacks on Adikor Huld's character. But she hardly knows the man. Adikor was my father's man-mate; granted, I saw Adikor only briefly whenever Two became One—he has his own son, young Dab there, here

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in this chamber, and his woman, Lurt, seated next to Dab. But, still, we met frequently—much more frequently than Daklar and he did."

She moved next to Adikor and placed a hand on his shoulder. "I stand here, the daughter of the man Adikor is accused of killing, and say to you that I do not think he did it." She paused, looked briefly down at Adikor, then met Adjudicator Sard's gaze from across the room.

"You *saw* the alibi recording," prodded Bolbay, still straddling her saddle-seat at the side of the room, in the first row of spectators. Sard shushed her.

"Yes," said Jasmel. "Yes, I did. I knew that my father had a damaged jaw. It pained him occasionally, especially on cold mornings. I hadn't known who had caused the damage—he never said. But he did say that it was long ago, that the person who had done it was extremely contrite, and that he'd forgiven the individual." She paused. "My father was good at gauging character. He would not have partnered with Adikor had he thought there the slightest possibility that Adikor would repeat his actions." She looked at Adikor, then back at the adjudicator. "Yes, my father is missing. But I don't think he was murdered. If he *is* dead, it was because of an accident. And if he is not—"

"Do you think him injured?" asked Adjudicator Sard. Jasmel was taken aback; it was unusual for the adjudicator to ask direct questions.

"He might be, Adjudicator."

But Sard shook her head. "Child, I sympathize with you. I really do. I know all too well what it's like to lose a parent. But what you're saying makes no sense. Men searched the mines for your father. Women were called in to search as well, even though it was Last Five. *Dogs* were brought in to search, too."

"But if he were dead," said Jasmel, "his Companion would have broadcast a locator signal, at least for a while. They scanned for it with portable equipment, and found nothing."

"True," said Sard. "But if his Companion had been deliberately disabled or destroyed, there would be no signal."

"But there's no evidence—"

"Child," said the adjudicator, "men have been known to disappear before. If circumstances are untenable in their personal lives, some have gouged out their own implants and headed into the wilderness. They shed all trappings of advanced civilization and join one of the communities that choose to live by traditional means, or they simply fend for themselves and live a nomadic life. Is there anything that might have made your father wish to disappear?"

"Nothing," said Jasmel. "I saw him when Two last become One, and he was fine."

"Briefly," said the adjudicator.

"Pardon?"

"You saw him briefly." Sard evidently noted Jasmel's eyebrow going up. "No, I haven't looked at your alibi archive; you've been accused of no crime, after all. But I did make some inquiries; it's prudent for an adjudicator to do so in a case as unusual as this. So I ask again, was there any reason your father would choose to disappear? He could simply have eluded Adikor down in the mine, after all, then waited until none of the mining robots were about and gone up the elevator."

"No, Adjudicator," said Jasmel. "I saw no evidence of mental instability, no sign that he wasn't happy—well, as happy as one who had lost a mate could be."

"I'll vouch for that," said Adikor, speaking directly to the adjudicator. "Ponter and I were very happy together."

"Your word is somewhat suspect, given the present circumstances," said Sard. "But, again, I have made my own inquires, and they confirm what you have said. Ponter had no debts he could not handle, no enemies, no *nadalp*—no reason to leave behind a family and a career."

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"Exactly," said Adikor, knowing that yet again he should be quiet but being unable to control himself.

"So," said Adjudicator Sard, "if he had no reason to wish to disappear, and no mental instability, then we return to Bolbay's assertion. If Ponter Boddit were merely injured, or dead by natural causes, the search teams would have found him."

"But—" said Jasmel.

"Child," said, Sard, "if you have some proof—not simple assertions on your part, but actual evidence—that Adikor Huld is not guilty, let's have it."

Jasmel looked at Adikor. Adikor looked at Jasmel. Except for the odd person coughing or shifting in his or her chair, the giant hall was quiet.

"Well?" said the adjudicator. "I'm waiting."

Adikor shrugged at Jasmel; he had no idea whether presenting this would be the right thing to do. Jasmel cleared her throat. "Yes, Adjudicator, there is one other possibility . . ."

Chapter 27

It had been an uncomfortable night for Mary.

Reuben Montego had wind chimes in his backyard; Mary thought all people with wind chimes should be shot, but, well, given that Reuben *did* have a couple of acres of land, they probably normally didn't disturb anyone else. Still, the constant tinkling had made it hard for her to get to sleep.

There'd been much discussion of sleeping arrangements. Reuben had a queen-size bed in his bedroom, a couch upstairs in his office, and another down in the living room. Unfortunately, neither of the couches folded out into beds. Ultimately, they agreed to give Ponter the bed; he needed it more than anyone else. Reuben took the upstairs couch, Louise had the downstairs couch for the first night, and Mary slept in a La-Z-Boy, also in the living room.

Ponter was indeed sick—but Hak wasn't. Mary, Reuben, and Louise had agreed to take turns giving further language lessons to the implant. Louise said she was a night person, anyway, so Hak could be taught pretty much around the clock now. And Louise had indeed disappeared into Ponter's room a little before 10:00 P.M., not coming down to the living room again until after 2:00 A.M. Mary wasn't sure if it was the sound of Louise's arrival that woke her, or whether she had really already been awake, but she knew she had to go up now and help Hak learn more English.

Speaking to the Companion *was* uncomfortable for Mary, not because she was unnerved talking to a computer—far from it; she was fascinated—but because she had to go alone into Ponter's upstairs bedroom, and because she had to close the door behind her, lest the noise of her conversations with the Companion disturb Reuben sleeping next door.

She was astonished by how much more fluent Hak had become in the hours the Companion had spent talking with Louise.

Fortunately, Ponter slept right through the language lesson, although Mary did have a brief moment of panic when he suddenly moved, rolling over on his side. If Mary understood what Hak was trying to convey, the Companion was pumping white noise through Ponter's auditory implants so that the quiet conversations Hak was having wouldn't disturb Ponter.

Mary only managed about an hour of naming nouns and acting out verbs for Hak before she was too tired to go on. She excused herself and went back downstairs. Louise had stripped down to her bra and panties, and was lying on the couch, partly covered by an afghan.

Mary leaned back in the recliner, and this time, out of sheer exhaustion, fell quickly to sleep.

By morning, Ponter's fever had apparently broken; perhaps the aspirin and

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antibiotics Reuben had given him were helping. The Neanderthal got out of bed and came downstairs—and, to Mary's shock, he was absolutely naked. Louise was still asleep, and Mary, curled up in the recliner, had only recently awoken. For half a second, she was afraid Ponter had come down looking for her or—no, doubtless, if he were interested in anyone, it was surely the young, beautiful French-Canadian.

But although he glanced briefly at both Louise and Mary, it turned out he was really heading for the kitchen. He apparently hadn't noticed that Mary's eyes were open.

She was going to speak up, objecting to his nudity, but, well . . .

My goodness, Mary thought, as he crossed through the living room. *My goodness*. He might not be much to look at above the neck, but . . .

She swiveled her head to watch his buns as he disappeared into the kitchen, and she watched again as he reemerged, holding one of Reuben's cans of Coke; Reuben had a whole shelf of his fridge devoted to the stuff. The scientist in Mary was fascinated to see a Neanderthal in the flesh, and—

And the woman in her simply enjoyed watching Ponter's muscular body move.

Mary allowed herself a little smile. She'd thought, perhaps, that she'd never be able to look at a man in that way again.

It was nice to know she still could.

Mary, Reuben, and Louise had been repeatedly interviewed by phone now, and Reuben, with Inco's permission, had organized a press conference—all three of them standing around a speaker phone in a conference call to journalists, who were shooting the proceedings through the living-room window with zoom lenses.

Meanwhile, tests were being done for smallpox, bubonic plague, and a range of other diseases. Blood samples had been flown in Canadian Forces jets to the Centers for Disease Control and Prevention in Atlanta and to the level-four hot lab at the Canadian Science Centre for Human and Animal Health in Winnipeg. The results from the first round of cultures came in at 11:14 A.M. No pathogens had been found in Ponter's blood yet, and no one else who had been with him—including all the others now quarantined at St. Joseph's—were showing any signs of illness. While other cultures were being tested, the microbiologists were also looking at blood samples for unknown pathogens—cells or other inclusions of kinds they'd never seen before.

"It's a pity he's a physicist rather than a physician," said Reuben to Mary, after the press conference.

"Why?" asked Mary.

"Well, we're lucky we have any useful antibiotics left to offer him. Bacteria build up immunity over time; I usually give my patients erythromycin, because penicillin is so ineffective these days, but I actually gave Ponter penicillin first. It's based on bread mold, of course, and if Ponter's people don't make bread, then they may never have stumbled on to it, so it might be very effective against any bacteriological infection he brought with him from his world. Then I gave him erythromycin, and a bunch of others, to combat anything he caught here. Still, Ponter's people probably have antibiotics of their own, but they're likely different from those we've discovered. If he could tell us what they use, we'd have a new weapon in the war on disease—one that our bacteria don't yet have any resistance to."

Mary nodded. "Interesting," she said. "It's too bad the gateway between his world and ours closed almost immediately. There are probably lots of fascinating trade possibilities between two versions of Earth. Pharmaceuticals are surely just the tip of the iceberg. Most of the foods we eat don't occur in the wild. He may not care for wheat products, but the modern potato and tomato, corn,

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the domestic chicken and pig and cow—all of them are forms of life we essentially created through selective breeding. We could trade those for whatever foodstuffs they've got."

Reuben nodded. "And that's just for starters. There's doubtless lots more to be done in terms of trading mining sites. I bet we know where all sorts of valuable minerals, fossils, and so on are that they haven't found, and vice versa."

Mary realized he was probably right. "Anything natural that's older than a few tens of thousand of years would be present in both worlds, wouldn't it? Another Lucy, another *Tyrannosaurus* Sue, another set of Burgess Shale fossils, another Hope diamond—at least, the original uncut stone." She paused, considering it all.

By the middle of the day, Ponter was clearly feeling much better. Mary and Louise both looked in at him, covered by a blanket, lying on the bed, as he slept quietly. "I'm glad he doesn't snore," said Louise. "With a nose that big . . ."

"Actually," said Mary, softly, "that's probably *why* he doesn't snore; he's getting plenty of airflow."

Ponter rolled over on the bed.

Louise looked at him for a moment, then turned back to Mary. "I'm going to have a shower," she said.

Mary's period had begun that morning; she'd certainly like a shower herself. "I'll have one after you."

Louise headed into the bathroom, closing the door behind her.

Ponter stirred again, then woke. "Mare," he said softly. He slept with his mouth closed, and his voice on waking didn't sound at all raw.

"Hello, Ponter. Did you sleep well?"

He raised his long, blond eyebrow—Mary still hadn't gotten used to the sight of it rolling up his browridge—as if he thought it a preposterous question.

He cocked his head; Louise had started the shower. And then he flared his nostrils, each the diameter of a twenty-five-cent piece, and looked at Mary.

And suddenly she realized what was happening, and she felt enormously embarrassed and uncomfortable. He could smell that she was menstruating. Mary backed across the room; she could hardly wait for her turn at the shower.

Ponter's expression was neutral. "Moon," he said.

Yes, thought Mary, *it's that time of the month.* But she certainly didn't want to talk about it. She hurried back downstairs.

Chapter 28

Adjudicator Sard had an expression on her lined, wise face that conveyed, "This had *better* be good." "All right, child," she said to Jasmel, who was still standing next to Adikor in the Council chamber. "What other explanation, besides violent action, is there for your father's disappearance?"

Jasmel was quiet for a moment. "I would gladly tell you, Adjudicator, but . . ."

Sard was growing more impatient than usual. "Yes?"

"But, well, Scholar Huld could explain it much better than I."

"Scholar Huld!" exclaimed the adjudicator. "You propose the *accused* should speak on his own behalf?" Sard shook her head in astonishment.

"No," said Jasmel quickly, clearly realizing Sard was about to prohibit this outlandish notion. "No, nothing like that. He would simply address some points of technical information: information about quantum physics, and—"

"Quantum physics!" said Sard. "What bearing could quantum physics possibly have on this case?"

"It may in fact be the key," said Jasmel. "And Scholar Huld can present the information much more eloquently . . ." she saw Sard frowning ". . . and *succinctly* than could I."

"Is there no one else who could provide the same information?" asked the

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adjudicator.

"No, Adjudicator," said Jasmel. "Well, there *is* a group of females in Evsoy engaged in similar research, but—"

"Evsoy!" exclaimed Sard, as if Jasmel had named the far side of the Moon. She shook her head again. "Oh, all right." She fixed a predator's gaze on Adikor. "Do be brief, Scholar Huld."

Adikor wasn't sure if he should rise, but he was getting tired of sitting on the stool, and so he did. "Thank you, Adjudicator," he said. "I, ah, I appreciate you allowing me to speak other than simply in response to questions posed."

"Don't make me regret my indulgence," said Sard. "Get on with it."

"Yes, of course," said Adikor. "The work Ponter Boddit and I were doing involved quantum computing. Now, what quantum computing does—at least in one interpretation—is reach into countless parallel universes in which identical quantum computers also exist. And all these quantum computers simultaneously tackle different portions of a complex mathematical problem. By pooling their capabilities, they get the work done much more quickly."

"Fascinating, I'm sure," said Sard. "But what has this to do with Ponter's alleged death?"

"It is, ah, my belief, Worthy Adjudicator, that when we were last running our quantum-computing experiment, a . . . a macroscopic passage of some sort . . . might have opened up into another one of these universes, and Ponter fell through that, so—"

Daklar Bolbay snorted derisively; others in the audience followed her lead. Sard was once again shaking her head in disbelief. "You expect me to believe that Scholar Boddit vanished into *another universe?*"

Now that the crowd knew which way the adjudicator's sentiments were leaning, they felt no need to hold back. There was out-and-out laughter emanating from many seats.

Adikor felt his pulse quickening, and his fists clenching—which was the last thing he should be doing, he knew. He couldn't do anything about the tachycardia, but he slowly managed to force his hands to open. "Adjudicator," he said, managing as deferential a tone as he could, "the existence of parallel universes underlines much theoretical thought in quantum physics these days, and—"

"Silence!" shouted Sard, her deep voice thundering in the hall. Some audience members gasped at her volume. "Scholar Huld, in all my hundreds of months as an adjudicator, I have never heard such a flimsy excuse. You think those of us who didn't go to your vaunted Science Academy are ignoramuses who can be fooled by outlandish talk?"

"Worthy Adjudicator, I—"

"Shut up," said Sard. "Just shut up and sit back down."

Adikor took a deep breath, and held it—just as they'd taught him to those 250-odd months ago when he'd been treated for having punched Ponter. He let the breath out slowly, imagining his fury escaping with it.

"I said sit down!" snapped Sard.

Adikor did so.

"Jasmel Ket!" said the adjudicator, turning her fiery stare now on Ponter's daughter.

"Yes, Adjudicator?" said Jasmel, her voice quavering.

The adjudicator took a deep breath of her own, composing herself. "Child," she said, more calmly, "child, I know you lost your mother recently to leukemia. I can only imagine how unfair that must have seemed to you, and little Megameg." She smiled at Jasmel's sister, new wrinkles piling atop the old ones on her face. "And now, it seems perhaps your father is dead, too—and, again, not the inevitable death that comes eventually to us all, but unexpectedly, without warning, and at a young age. I can understand why you are so reluctant to give up on him, why you might accept an outrageous explanation . . ."

"It's not like that, Adjudicator," said

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Jasmel.

"Isn't it? You're desperate for something to hold on to, some hope to cling to. Isn't that so?"

"I—I don't think so."

Sard nodded. "It will take time to accept what has happened to your father. I know that." She looked around the chambers, and then finally her gaze landed on Adikor. "All right," Sard said. She was quiet for a moment, apparently considering. "All right," she said again. "I'm prepared to rule. I do believe it is just and appropriate to find that a good circumstantial case for the crime of murder has been made, and I therefore order this matter be tried by a trio of adjudicators, assuming anyone still wishes to pursue the matter." She looked now at Bolbay. "Do you wish to press the charge further, on behalf of your minor ward, Megameg Bek?"

Bolbay nodded. "I do."

Adikor felt his heart sink.

"Very well," said Sard. She consulted a datapad. "A full tribunal will be convened in this Council hall five days from now, on 148/119/03. Until such time, you, Scholar Huld, will continue to be under judicial scrutiny. Do you understand?"

"Yes, Adjudicator. But if I could only go down to—"

"No buts," snapped Sard. "And one more thing, Scholar Huld. I will be leading the tribunal, and I will be briefing the other two adjudicators. I grant there was a certain drama in having Ponter Boddit's daughter speak for you, but the effect won't last for a second try. I strongly suggest you find someone more appropriate to speak for you next time."

Chapter 29

By late morning, Reuben Montego had good news to report. He'd been talking by phone and email with various experts at LCDC headquarters and the CDC, as well as the hot lab in Winnipeg. "You've surely noticed that Ponter doesn't seem to like grain or dairy products," said Reuben, sitting now in his living room and drinking the strong-smelling Ethiopian coffee Mary had discovered he liked.

"Yes," said Mary, feeling much more comfortable after her shower, even if she did have to put on the same clothes she'd worn the day before. "He loves meat and fresh fruit. But he doesn't seem to have much interest in traditional from-the-ground crops, bread, or milk."

"Right," said Reuben. "And the people I've been talking to tell me that's very positive for us."

"Why?" asked Mary. She couldn't abide Reuben's coffee—although they'd asked for some Maxwell House, and, yes, some chocolate milk, to be delivered today, along with more clothes. For the moment, she was getting her caffeine from one of his cans of Coke.

"Because," said Reuben, "it suggests that Ponter doesn't come from an agricultural society. What I've gathered from Hak more or less confirms that. Ponter's version of Earth seems to have a much lower population than this one. Consequently, they don't practice farming or animal husbandry, at least not on anything like the scales we've been for the last few thousand years."

"I would have thought that you needed those things to support any sort of civilization, no matter what the population," said Mary.

Reuben nodded. "I'm looking forward to when Ponter can answer questions about that. Anyway, I'm told that most serious diseases that affect us started in domesticated animals, and then transferred to people. Measles, tuberculosis, and smallpox all came from cattle; the flu came from pigs and ducks; and whooping cough came from pigs and dogs."

Mary frowned. Out the window, she could see a helicopter flying by; more reporters. "That's right, now that I think about it."

"And," continued Reuben, "plague-

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like diseases only evolve in areas of high population density, where there are plenty of potential victims. In areas of low density, such disease germs apparently aren't evolutionarily viable; they kill their own hosts, then have nowhere else to go."

"Yes, I suppose that's right, too," said Mary.

"It's probably too simplistic to say that if Ponter doesn't come from an agricultural society, then he must come from a hunting-and-gathering one," said Reuben. "But, still, that does seem the best model, at least from our world, of what Hak has tried to describe. Hunter-gather societies *do* have much lower population densities, and also much less disease."

Mary nodded.

Reuben continued: "I'm told it's the same principle as with the first European explorers and the natives here in the Americas. The explorers all came from agricultural, high-density societies, and were lousy with plague germs. The natives were all from low-density societies, with little or no animal husbandry; they didn't have plague germs of their own, or any of the diseases that transfer from livestock to humans. That's why the devastation only went one way."

"I thought syphilis was brought back to the Old World from the New," said Mary.

"Well, yes, there's some evidence for that," said Reuben. "But although syphilis perhaps originated in North America, it wasn't sexually transmitted here. It was only when it got back to Europe that it took up that opportunistic means of transmission and became a major cause of death. In fact, the endemic, nonvenereal form of syphilis still exists, although now it's mostly only found among Bedouin tribes."

"Really?"

"Yes. So, rather than syphilis being a counterexample of the generally one-way course of epidemic disease, it confirms that the development of epidemics requires social conditions typical of overcrowded civilization."

Mary digested this for a moment. "So that means you, Louise, and I are probably going to be OK, right?"

"That seems the most probable interpretation: Ponter is suffering from something he got here, but likely has brought nothing over from his side that we have to worry about."

"But what about him? Is Ponter going to be all right?"

Reuben shrugged. "I don't know," he said. "I've given him enough broad-spectrum antibiotics to kill most known bacterial infections, Gram-negative and Gram-positive. Viral infections don't respond to antibiotics, though, and there's no such thing as a broad-spectrum antiviral. Unless we actually get evidence that he's got a specific viral condition, pumping random antivirals into him will probably do more harm than good." He sounded as frustrated as Mary felt. "There's really nothing else for us to do now but wait and see."

The Exhibitionists swarmed onto the Council-chamber floor, surrounding Adikor Huld and shouting questions at him, like spears being shoved into an ambushed mammoth. "Are you surprised by Adjudicator Sard's ruling?" asked Lulasm.

"Who are you going to have speak on your behalf in front of the tribunal?" demanded Hawst.

"You've got a son from generation 148; is he old enough to understand what might happen to you—and to him?" said an Exhibitionist whose name Adikor didn't know, a 147 who presumably had a younger audience watching him over their Voyeurs.

Exhibitionists shouted questions at poor Jasmel, too. "Jasmel Ket, how are relations between you and Daklar Bolbay now?" "Do you really believe your father might still be alive?" "If the tribunal does hand down a murder conviction against Scholar Huld, how will you

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feel about having defended a guilty person?"

Adikor felt anger growing within him, but he fought, fought, *fought* to conceal it. He knew the Companion-broadcasts from the Exhibitionists were being monitored by countless people.

For her part, Jasmel was refusing to respond at all, and the Exhibitionists at last left her alone. Eventually, those grilling Adikor had their fill, and they filed out of the chamber, leaving him and Jasmel alone in the vast room. Jasmel met Adikor's eyes for a moment, then looked away. Adikor wasn't sure what to say to her; he'd been adept at reading her father's moods, but Jasmel had much of Klast in her, too. Finally, to fill the silence between them, Adikor said, "I know you did the best you could."

Jasmel looked now at the ceiling, with its painted auroras and centrally mounted timepiece. Then she lowered her gaze, facing Adikor. "Did you do it?" she asked.

"What?" Adikor's heart pounded. "No, of course not. I love your father."

Jasmel closed her eyes. "I never knew it was you who had tried to kill him before."

"I wasn't trying to kill him. I was just angry, that's all. I thought you understood that; I thought—"

"You thought because I continued to speak on your behalf that I wasn't troubled by what I saw? That was my *father!* I saw him spitting out his own teeth!"

"It was long ago," said Adikor, softly. "I, ah, I didn't remember it as quite so . . . so bloody. I *am* sorry you had to see that." He paused. "Jasmel, don't you understand? I *love* your father; I owe everything that I am to him. After that . . . incident . . . he could have pressed charges; he could have had me sterilized. But he didn't. He understood that I had—have—a sickness, an inability sometimes to control my anger. I owe that I am still whole to him; I owe that I have a son, Dab, to him. My overwhelming feeling toward your father is *gratitude*. I would never hurt him. I couldn't."

"Maybe you got tired of being in his debt."

"There was no debt. You're still young, Jasmel, and you haven't yet bonded, but soon you will, I know. There is no debt between people who are in love; there is only total forgiveness, and going forward."

"People don't change," said Jasmel.

"Yes, they do. I did. And your father knew that."

Jasmel was quiet for a long time, then: "Who are you going to have speak for you this time?"

Adikor had just ignored the question when it had been shouted at him by the Exhibitionists. But now he gave it serious thought. "Lurt is the natural choice," he said. "She's a 145, old enough that the adjudicator should respect her. And she said she'd do anything to help."

"I hope . . . ," said Jasmel. She continued again a moment later. "I hope she does well for you."

"Thank you. What are you going to do now?"

Jasmel looked directly at Adikor. "For now—for right now—I just need to get away from here . . . and from you."

She turned and walked out of the massive Council chamber, leaving Adikor all alone.

Chapter 30

DAY FIVE
Tuesday, August 6
148/118/28

NEWS SEARCH
Keyword(s): *Neanderthal*

An Islamic spiritual leader has denounced the so-called Neanderthal man as clearly the botched product of Western genetic-engineering experiments. The Wilayat al-Faqih in Iran is calling on the Canadian government to

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admit that Ponter Boddit is the product of a wickedly immoral recombinant-DNA procedure . . .

Ottawa is being pressured to grant Canadian citizenship to Ponter Boddit—and the request is coming from an unusual source. U.S. president George W. Bush today asked Prime Minister Jean Chrétien to expedite the process by which the Neanderthal is made an official Canadian. Ponter Boddit has indicated that he was born in a location corresponding to Sudbury, Ontario, in his world. "If he was born in Canada," says Bush, "then he's a Canadian."

The U.S. president is pushing for Boddit to be issued a Canadian passport, so the Neanderthal can travel freely to the United States once the quarantine is lifted, thereby ending the debate on Capitol Hill about whether he could be allowed through U.S. Customs.

Section 5, Paragraph 4, of the Canadian Citizenship Act gives broad discretion, which Bush is urging be invoked: "In order to alleviate cases of special and unusual hardship or to reward services of an exceptional value to Canada, and notwithstanding any other provision of this Act, the Governor in Council may, in his discretion, direct the Minister to grant citizenship to any person . . ."

An Internet petition with more than 10,000 names gathered worldwide has been forwarded to Canada's Minister of Health, demanding that Ponter Boddit be permanently quarantined . . .

Inco shares closed today at a 52-week high . . .

"It's a media circus," said long-time Sudbury Rotarian Bernie Monks. "Northern Ontario hasn't seen anything like this since the Dionne Quintuplets were born, back in 1934 . . ."

Job offers continue to pour in for Ponter Boddit. Japan's NTT Basic Research Laboratory has offered him a directorship of a new quantum-computing unit. Microsoft and IBM have also offered him contracts, with generous cash/stock packages. MIT, CalTech, and eight other universities have offered him faculty positions. The RAND Corporation has likewise made an overture to him, as has Greenpeace. No word yet from the Neanderthal about whether any of these positions appeal to him . . .

A coalition of scientists in France has issued a statement saying that although Ponter Boddit's arrival on this Earth did indeed take place on Canadian soil, he clearly was not born in that nation, and no Neanderthal ever lived in North America. His citizenship, they contend, should therefore be French, since the youngest Neanderthal fossils are found in that country . . .

Civil-rights advocates on both sides of the border are condemning the forced quarantine of the so-called Neanderthal man, saying there is no evidence he poses a medical threat to anyone . . .

Blood test after blood test came back negative. Whatever Ponter had been suffering from seemed to have abated, and there was no evidence that he was carrying anything dangerous to the humans of this world. Still, the LCDC wasn't ready to cancel the quarantine yet.

Ponter was wearing his own shirt again today, the one he'd had on when he arrived here. The RCMP had delivered a small wardrobe of additional clothes for him bought at the local Mark's Work Wearhouse, but they really didn't fit very well; clothing didn't seem to come off the rack for a person who looked like a slightly squished version of Mr. Universe.

Ponter's—or Hak's—English was get-

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ting remarkably good. The Companion didn't have the *ee* phoneme in its preprogrammed repertoire, but it had now recorded both Mary and Reuben saying that sound, and would play back the appropriate version as required to render English words it otherwise couldn't articulate. But it sounded funny hearing her name said as "Mare-ee," half in one of Hak's voices and half in either her own or Reuben's, so Mary told the Companion not to bother; people periodically called her "Mare," anyway, and it would be just fine for Hak to continue to do that, too. Louise likewise told Hak it was all right if the Companion went on referring to her as just "Lou."

Finally, Hak announced that it had amassed a sufficient vocabulary for truly meaningful conversations. Yes, it said, there would be gaps and difficulties, but these could be worked out as they went along.

And so, while Reuben was busy going over more test results on the phone with other doctors, and while Louise, the night owl, was sleeping upstairs, having accepted Ponter's offer to use the bed when he wasn't, Mary and Ponter sat in the living room and had their first real chat. Ponter spoke softly, making sounds in his own language, and Hak, using its male voice, provided an English translation: "It is good to talk."

Mary made a small, nervous laugh. She'd been frustrated by her inability to communicate with Ponter, and now that they *could* talk, she didn't know what to say to him. "Yes," she said. "It's good to talk."

"A beautiful day," said Ponter's translated voice, looking out the living-room's rear window.

Mary laughed again; heartily, this time. Talking about the weather—a pleasantry that transcended species boundaries. "Yes, it is."

And then she realized that it wasn't that she didn't know what to say to Ponter. Rather, she had so many questions, she didn't know where to begin. Ponter *was* a scientist; he must have some sense of what his people knew about genetics, about the split between genus *Homo* and genus *Pan*, about . . .

But no. No. Ponter was a person—first and foremost, he was a person, and one who had gone through a harrowing ordeal. The science could wait. Right now, they would talk about him, about how he was doing. "How do you feel?" Mary asked.

"I am fine," said the translated voice.

Mary smiled. "I mean really. How are you really doing?"

Ponter seemed to hesitate, and Mary wondered if Neanderthal men shared with males of her kind a reluctance to talk about feelings. But then he exhaled through his mouth, a long, shuddering sigh.

"I am frightened," he said. "And I miss my family."

Mary lifted her eyebrows. "Your family?"

"My daughters," he said. "I have two daughters, Jasmel Ket and Megameg Bek."

Mary's jaw dropped slightly. It hadn't even occurred to her to think about Ponter's family. "How old are they?"

"The older one," said Ponter, "is—I know in months, but you reckon time mostly in years, do you not? The older one is—Hak?"

Hak's female voice chimed in. "Jasmel is nineteen years old; Megameg is nine."

"My goodness," said Mary. "Will they be OK? What about their mother?"

"Klast died two tenmonths ago," said Ponter.

"Twenty months," added Hak, helpfully. "One-point-eight years."

"I'm sorry," said Mary softly.

Ponter nodded slightly. "Her cells, in her blood, they changed . . ."

"Leukemia," Mary said, providing the word.

"I miss her every month," said Ponter.

Mary wondered for a moment if Hak had translated that just right; surely Ponter meant he missed her every day. "To

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have lost both parents . . ."

"Yes," said Ponter. "Of course, Jasmel is an adult now, so . . ."

"So she can vote, and so forth?" asked Mary.

"No, no, no. Did Hak do the math incorrectly?"

"I most certainly did not," said Hak's female voice.

"Jasmel is far too young to vote," said Ponter. *I* am far too young to vote."

"How old do you have to be in your world to vote?"

"You must have seen at least 667 moons—two-thirds of the traditional thousand-month lifetime."

Hak, evidently wanting to dispel the notion that it was mathematically challenged, quickly supplied the conversions: "One can vote at the age of fifty-one years; a traditional lifespan averaged seventy-seven years, although many live much longer than that these days."

"Here, in Ontario, people get to vote when they turn eighteen," said Mary. "Years, that is."

"Eighteen!" exclaimed Ponter. "That is madness."

"I don't know of any place where the voting age is higher than twenty-one years."

"This explains much about your world," said Ponter. "We do not let people shape policy until they have accumulated wisdom and experience."

"But then if Jasmel can't vote, what is it that makes her an adult?"

Ponter lifted his shoulders slightly. "I suppose such distinctions are not as significant on my world as they are here. I mean, here I have seen that people can legally use alcohol or smoke tobacco—two of the least appealing products of your agriculture—once they have reached a certain age; I also understand that they can operate cars. But we do none of those things. Still, at 250 months, an individual does take legal responsibility for himself or herself, and usually is on the verge of establishing his or her own home." He shook his head. "I wish I could let Jasmel and Megameg know that I am still alive, and am thinking about them. Even if there is no way I can go home, I would give anything just to get a message to them."

"And is there really no way for you to go home?" asked Mary.

"I cannot see how I could. Oh, perhaps if a quantum computer could be built here, and the conditions that led to my . . . transfer . . . could be precisely duplicated. But I am a theoretical physicist; I have only the vaguest of senses of how one builds a quantum computer. My partner, Adikor, knows how, of course, but I have no way of contacting him."

"It must be very frustrating," said Mary.

"I am sorry," said Ponter. "I did not mean to transfer my problems to you."

"That's all right," said Mary. "Is there—is there anything we, any of us, can do to help?"

Ponter said a single, sad-sounding Neanderthal syllable; Hak rendered it as "No."

Mary wanted to cheer him up. "Well, we shouldn't be in quarantine too much longer. Maybe after we're out, you can travel around, see some sights. Sudbury is a small town, but—"

"Small?" said Ponter, deep-set eyes wide. "But there are—I do not know how many. Tens of thousands at least."

"The Sudbury metropolitan area has 160,000 people in it," said Mary, having read that in a guide book in her hotel room.

"One hundred and sixty thousand!" repeated Ponter. "And this is a small town? You, Mare, come from somewhere else, do you not? A different town. How many people live there?"

"The actual city of Toronto is 2.4 million people; greater Toronto—a continuous urban area with Toronto at its heart—is maybe 3.5 million."

"Three and a half million?" said Ponter, incredulously.

"Give or take."

"How many people are there?"

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"In the whole world?" asked Mary.

"Yes."

"A little over six billion."

"A billion is . . . a thousand times a million?"

"That's right," said Mary. "At least here in North America. In Britain—no, forget it. Yes, a billion is a thousand million."

Ponter sagged in his chair. "That is a . . . a staggering number of people."

Mary raised her eyebrows. "How many people are there on your world?"

"One hundred and eighty-five million," said Ponter.

"Why so few?" asked Mary.

"Why so many?" asked Ponter.

"I don't know," replied Mary. "I never thought about it."

"Do you not—in my world, we know how to prevent pregnancy. I could perhaps teach you . . ."

Mary smiled. "We have methods, too."

Ponter lifted his eyebrow. "Perhaps ours work better."

Mary laughed. "Perhaps."

"Is there enough food for six billion people?"

"We mostly eat plants. We cultivate"—a *bleep*; Hak's convention upon hearing a word that wasn't yet in its database and that it couldn't figure out from context—"we grow them deliberately. I've noticed you don't seem to like bread"—another *bleep*—"um, food from grain, but bread, or rice, is what most of us eat."

"You manage to comfortably feed six billion people with *plants?*"

"Well, ah, no," said Mary. "About half a billion people don't have enough to eat."

"That is very bad," said Ponter, simply.

Mary could not disagree. Still, she realized with a start that Ponter had, to this point, been exposed only to a sanitized view of Earth. He'd seen a little TV, but not enough to really open his eyes. Still, it did indeed seem that Ponter was going to spend the rest of his life on this Earth. He needed to be told about war, and the crime rate, and pollution, and slavery—the whole bloody smear across time that was human history.

"Our world is a complex place," said Mary, as if that excused the fact that people were starving.

"So I have seen," said Ponter. "We have only one species of humanity, although there were more in the past. But you seem to have three or four."

Mary shook her head slightly. "What?" she said.

"The different types of human. You are obviously of one species, and Reuben is of another. And the male who helped rescue me, he seemed perhaps to be of a third species."

Mary smiled. "Those aren't different species. There's only one species of humanity here, too: *Homo sapiens*."

"You can all breed with each other?" asked Ponter.

"Yes," said Mary.

"And the offspring are fertile?"

"Yes."

Ponter frowned. "You are the geneticist," he said, "not I, but . . . but . . . if they can all breed with each other, then why the diversity? Would not over time all humans end up looking similar, a mixture of all the possible traits?"

Mary exhaled noisily. She hadn't quite expected to get into that particular mess so soon. "Well, umm, in the past—not today, you understand, but . . ." She swallowed. "Well, not as *much* today, but in the past, people of one race"—a different bleep; a recognized word that couldn't be translated in this context—"people of one skin color didn't have much to do with people of another color."

"Why?" said Ponter. A simple question, so simple, really . . .

Mary lifted her shoulders slightly. "Well, the coloration differences arose originally because populations were geographically isolated. But after that . . . after that, limited interaction occurred due to ignorance, stupidity, hatred."

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"Hatred," repeated Ponter.

"Yes, sad to say." She shrugged a little. "There is much in my species' past that I'm not proud of."

Ponter was quiet for a long moment. "I have," he said at last, "wondered about this world of yours. I was surprised when I saw the images of skulls at the hospital. I have seen such skulls, but on my world they are known only from our fossil record. It startled me to see flesh on what to this point I had only known as bone."

He paused again, looking at Mary as if still disconcerted by her appearance. She shifted slightly in her chair.

"We knew nothing of your skin color," said Ponter, "or the color of your hair. The"—*bleep*; Hak also bleeped as a placeholder when a word was omitted because the English equivalent wasn't yet in the Companion's vocabulary—"of my world would be astonished to learn of the variety."

Mary smiled. "Well, it's not all natural," she said. "I mean, my hair isn't really this color."

Ponter looked astonished. "What color is it really?"

"Kind of a mousy brown."

"Why did you alter it?"

Mary shrugged a little. "Self-expression, and—well, I said it was brown, but, actually, it has a fair bit of gray in it. I—many people, actually—dislike gray hair."

"The hair of my kind turns gray as we age."

"That's what happens to us, too; nobody is born with gray hair."

Ponter frowned again. "In my language, the term for one who has knowledge that comes with experience and for the color hair turns is the same: Gray. I cannot imagine someone wanting to hide that color."

Mary shrugged once more. "We do a lot of things that don't make sense."

"That much is clearly true," said Ponter. He paused, as if considering whether to go on. "We have often wondered what became of your people . . . on our world, that is. Forgive me; I do not wish to sound"—*bleep*—"but you must know that your brains are smaller than ours."

Mary nodded. "About 10 percent smaller, on average, if I remember correctly."

"And you seemed physically weaker. Judging by attachment scars on your bones, your kind was believed to have had only half our muscle mass."

"I'd say that's about right," said Mary, nodding.

"And," continued Ponter, "you have spoken of your inability to get along, even with others of your own kind."

Mary nodded again.

"There is some archeological evidence for this among your kind on my world, too," said Ponter. "A popular theory is that you wiped each other out . . . what with being not all that intelligent, you see . . ." Ponter lowered his head. "I am sorry; again, I do not mean to upset you."

"That's all right," said Mary.

"I am sure there is a better explanation," said Ponter. "We knew so little about you."

"In a way," said Mary, "the knowledge that it *could* have gone another way—that we didn't necessarily have to end up surviving—is probably all to the good. It will remind my people of how precious life really is."

"This is not obvious to them?" asked Ponter, eyes wide in astonishment.

Chapter 31

Adikor finally left the Council chamber, walking slowly and sadly out the door. This was all madness—madness! He'd lost Ponter, and, as if that weren't devastating enough, now he would have to face a full tribunal. Whatever confidence he'd once had in the judicial system—an entity of which he'd only been vaguely aware to this point—had been shattered. How could an innocent, grieving person be hounded so?

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Adikor headed down a long corridor, its walls lined with square portraits of great adjudicators of the past, men and women who had developed the principles of modern law. Had this—this *travesty*—really been what they'd had in mind? He continued along, not paying much attention to the other people he occasionally passed . . . until a flash of orange caught his eye.

Bolbay, still wearing the color of the accuser, down at the end of the corridor. She'd tarried in the Council building, perhaps to avoid Exhibitionists, and was now making her own way outside.

Before he'd really given it any thought, Adikor found himself running down the corridor toward her, the moss carpet cushioning his footfalls. Just as she stepped out through the door at the end, exiting into the afternoon sun, he caught up with her. "Daklar!"

Daklar Bolbay turned, startled. "Adikor!" she exclaimed, her eyes wide. She raised her voice. "Whoever is monitoring Adikor Huld for his judicial scrutiny, pay attention! He is now confronting me, his accuser!"

Adikor shook his head slowly. "I'm not here to harm you."

"I have seen," said Bolbay, "that your deeds do not always match your intentions."

"That was *years* ago," said Adikor, deliberately using the noun that most emphasized the length of time. "I'd never hit anyone before that, and I've never hit anyone since."

"But you *did* do it then," said Bolbay. "You lost your temper. You lashed out. You tried to kill."

"No! No, I never wanted to hurt Ponter."

"It's inappropriate for us to be speaking," said Bolbay. "You must excuse me." She turned.

Adikor's hand reached out, grabbing hold of Bolbay's shoulder. "No, wait!"

Her face showed panic as it swung back to look at him, but she quickly changed her expression, staring meaningfully at his hand. Adikor removed it. "Please," he said. "Please, just tell me *why*. Why are you going after me with such . . . such *vindictiveness?* In all the time we've known each other, I've never wronged you. You must know that I loved Ponter, and that he loved me. He wouldn't possibly want you to pursue me like this."

"Don't play the innocent with me," said Bolbay.

"But I *am* innocent! Why are you doing this?"

She simply shook her head, turned around, and began walking away.

"Why?" Adikor called after her. *"Why?"*

"Maybe we can talk about your people," Mary said to Ponter. "Until now, we've only had Neanderthal fossils to study. There's been a lot of debate over various things, like, well, for instance, what your prominent browridges are for."

Ponter blinked. "They shield my eyes from the Sun."

"Really?" said Mary. "I guess that makes sense. But then why don't my people have them? I mean, Neanderthals evolved in Europe; my ancestors come from Africa, where it's much sunnier."

"We wondered that, too," said Ponter, "when we looked at Gliksin fossils."

"Gliksin?" repeated Mary.

"The type of fossil hominid from my world you most closely resemble. Gliksins didn't have browridges, so we had assumed that they were nocturnal."

Mary smiled. "I guess a lot of what people conclude from looking just at bones is wrong. Tell me: what do you make of this?" She tapped her index finger against her chin.

Ponter looked uncomfortable. "I know now that it is wrong, but . . ."

"Yes?" said Mary.

Ponter used an open hand to smooth down his beard, showing his chinless jaw. "We do not have such projections,

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so we assumed . . ."

"What?" said Mary.

"We assumed it was a drool guard. You have such tiny mouth cavities, we thought saliva was constantly dribbling out. Also, you *do* have smaller brains than we do, and, well, idiots often drool . . ."

Mary laughed. "Good grief," she said. "But, say, speaking of jaws, what happened to yours?"

"Nothing," said Ponter. "It is the same as it was before."

"I saw the x-rays that were taken of you at the hospital," said Mary. "Your mandible—your jawbone—shows extensive reconstruction."

"Oh, *that*," said Ponter, sounding apologetic. "I got hit in the face a couple of hundred months ago."

"What were you hit with?" asked Mary. "A brick?"

"With a fist," Ponter said.

Mary's own jaw dropped. "I knew Neanderthals were strong, but—*wow*. One punch did that?"

Ponter nodded.

"You're lucky you weren't killed," said Mary.

"We are *both* lucky—the punchee, as you might say, and the puncher."

"Why did someone hit you?"

"A stupid argument," said Ponter. "Certainly, he never should have done it, and he apologized profusely. I chose not to pursue the matter; if I had, he would have been tried for attempted murder."

"Could he have really killed you with one punch?"

"Oh, yes. I had reacted in time and lifted my head; that is why he connected with my jaw instead of the center of my face. Had he punched me there, he could well have caved in my skull."

"Oh, my," said Mary.

"He was angry, but I had provoked him. It was as much my fault as his."

"Could—could *you* kill someone with your bare hands?" asked Mary.

"Certainly," said Ponter. "Especially if I approached them from the rear." He intertwined his fingers, lifted his arms, then pantomimed smashing his interlocked fists down. "I could smash in a person's skull by doing that from behind. From the front, if I could get a good punch or kick into the center of someone's chest, I might crush their heart."

"But . . . but . . . no offense, but apes are very strong, too, and they rarely kill each other in fights."

"That is because in battles within a troop for dominance, ape fighting is ritualized and instinctive, and they simply slap each other—really just a display behavior. But chimpanzees do kill other chimpanzees, although they do it mostly with their teeth. Clenching the fingers into a fist is something only humans can do."

"Oh . . . my." Mary realized she was repeating herself, but couldn't think of anything better to sum up her feelings. "Humans here get into fights all the time. Some even make a sport of it: boxing, wrestling."

"Madness," said Ponter.

"Well, I agree, yes," said Mary. "But they almost never kill each other. I mean, it's almost impossible for a human to kill another human with his bare hands. We just aren't strong enough, I guess."

"In my world," said Ponter, "to hit is to kill. And so we *never* hit each other. Because any violence can be fatal, we simply cannot allow it."

"But you *were* hit," said Mary.

Ponter nodded. "It happened long ago, while I was a student at the Science Academy. I was arguing as only a youth can, as if winning mattered. I could see that the person I was arguing with was growing angry, but I continued to press my point. And he reacted in an . . . unfortunate manner. But I forgave him."

Mary looked at Ponter, imagining him turning the other long, angular cheek toward the person who had hit him.

Adikor had had his Companion sum-

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mon a public car to take him home, and he now was sitting out back, on the deck, alone, researching legal procedures. Someone might indeed be monitoring his Companion's transmissions, but he could still use it to tap into the world's accumulated knowledge, transferring the results to a datapad for easier viewing.

His woman-mate, Lurt, had agreed at once to speak on behalf of Adikor in front of the tribunal. But although she and others—she'd be allowed to call witnesses this time—could attest to Adikor's character and to the stability of his relationship with Ponter, it seemed unlikely that that would be enough to convince Adjudicator Sard and her associates to acquit Adikor. And so Adikor had begun digging into legal history, looking for other cases involving a charge of murder without a body having been found, in hopes of locating a previous judgment that might help him.

The first similar case he uncovered dated way back to generation 17. The accused was a man named Dassta, and he was said to have killed his woman-mate after supposedly sneaking into the Center. But her body was never located; she'd simply disappeared one day. The tribunal had ruled that without a body, no murder could be said to have occurred.

Adikor was thrilled by that discovery—until he read further in the law.

Ponter and Adikor had selected normal deck chairs—indeed, fragile chairs. It had been a sign of Ponter's unshakeable belief that Adikor was cured, that his temper would never again erupt into physical violence. But Adikor was so frustrated now that he smashed the armrest off his deck chair with a pounding of his fist, splinters of wood flying up. For prior cases to have legal significance, he read off his datapad, they had to date from within the last ten generations; society always advanced, said the Code of Civilization, and what people had done long ago had no bearing on the sensibilities of today.

Adikor continued searching and eventually turned up an intriguing case from generation 140—just eight generations before the current one—in which a man was accused of killing another male during a dispute over whether the latter had grown a home too close to the former's. But, again, no body was ever found. In that case, too, the tribunal had ruled that the lack of the body was enough to dismiss the accusation. That buoyed Adikor, except—

Except . . .

Generation 140. That was the period between—let's see—about 1,100 to 980 months ago; eighty-nine to seventy-nine years past. But the Companions had been introduced just shy of a thousand months ago; celebrations commemorating that were coming up.

Did the case in generation 140 date from before or after the introduction of the Companions? Adikor read further.

From before. *Gristle!* Bolbay would doubtless argue that this rendered it not germane. Sure, she would say, bodies and even living people could easily disappear during the dark times before the great Lonwis Trob had liberated us, but a case in which there *couldn't* have been a record of the accused's activities had no bearing on one in which the accused had contrived a situation specifically to *avoid* having a record made.

Adikor searched some more. He thought briefly that it might have been convenient if there were people who specialized in dealing with legal matters on behalf of others; that, it seemed, would be a useful contribution. He'd have gladly exchanged labor with someone familiar with this field who could do this research for him. But no; it was surely a bad idea. The mere existence of people who worked full-time on things legal would doubtless increase the number of such matters instigated, and—

Suddenly Pabo came tearing out of the house, barking. Adikor looked up, and, as it always did these days, his heart

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jumped. Could it be? Could it be?

But, no, it wasn't. Of course not. And, yet, it *was* someone Adikor hadn't expected to see: young Jasmel Ket. "Healthy day," she said, once she was within ten paces.

"Healthy day," Adikor replied, trying to keep his tone neutral.

Jasmel sat on the other deck chair, the one that had been her father's. Pabo knew Jasmel well; the dog had often come into the Center when Two became One, and was clearly pleased to see another familiar face. Pabo nuzzled Jasmel's legs, and Jasmel scratched the reddish-brown fur on the top of the dog's head.

"What happened to your chair?" asked Jasmel.

Adikor looked away. "Nothing."

Jasmel evidently decided not to pursue the point; after all, what had happened was obvious. "Did Lurt agree to speak for you?" she asked.

Adikor nodded.

"Good," said Jasmel. "I'm sure she'll do the best she can." She fell silent, for a time, then, glancing again at the damaged chair: "But . . ."

"Yes," said Adikor. "But."

Jasmel looked out at the countryside. Off in the distance, a mammoth was wandering by, stolid, placid. "Now that this matter has been referred to a full tribunal, my father's alibi cube has been moved to the wing of the dead. Daklar spent the afternoon reviewing parts of it, as she prepares to make her full case against you. That's her right, of course, as accuser speaking on behalf of a dead person. But I insisted she let me review Ponter's alibi archive with her. And I've looked at you and my father together, in the days leading up to his disappearance." She brought her gaze back to Adikor. "Bolbay can't see it but, then again, she has been alone for a long time. But—well, I told you I had a young man interested in me. Despite what you said about me not yet being bonded, I *know* what love looks like—and there is no doubt in my mind that you truly loved my father. After seeing you the way he saw you, I can't believe you would do anything to harm him."

"Thank you."

"Is . . . is there anything I can do to help you prepare to appear in front of the tribunal?"

Adikor shook his head sadly. "I'm not sure anything can save me or my relatives now."

Chapter 32

DAY SIX
Wednesday, August 7
148/119/29

NEWS SEARCH
Keyword(s): *Neanderthal*

Playgirl has sent a letter to Ponter Boddit, asking him if he'd like to pose nude . . .

"Does he have a soul?" said Reverend Peter Donaldson of Los Angeles's Church of the Redeemer. "That's the key question. And I say, no, he does not . . ."

"We believe the rush to grant Ponter Canadian citizenship is calculated to allow him to represent Canada in the next Olympic Games, and we call upon the IOC to specifically bar all but *Homo sapiens sapiens* from competing . . ."

Get yours now: T-shirts, with Ponter Boddit's face on them. S, M, L, XL, XXL, and Neanderthal sizes available.

The German Skeptics, headquartered in Nuremberg, today announced that there was no good reason to believe that Ponter Boddit comes from a parallel universe. "That would be the last interpretation to accept," said Executive Director Karl von Schlegel, "and should only be adopted after every other simpler alternative has

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been eliminated . . ."

Mounties today arrested three men found trying to infiltrate the cordon around Dr. Reuben Montego's home in Lively, a town 14 km south-west of Sudbury, where the Neanderthal man is quarantined . . .

There were many ways to pass time and it seemed that Louise and Reuben had found one of the oldest. Mary hadn't really looked at Reuben in that light, but, now that she did take stock of him, she realized he was indeed quite handsome. The shaved head wasn't her thing, but Reuben did have good, sturdy features, a dazzling smile, and intelligent eyes, and he was lean and nicely muscled.

And, of course, he had that wonderful accent—but that wasn't all. It turned out that he was fluent in French, meaning Louise and he could converse in her language. Plus, judging by his home, he obviously made a fair bit of money—not surprising, given he was a doctor.

Quite a find, as Mary's sister might say. Of course, Mary was sophisticated enough to understand that once the quarantine ended, Reuben and Louise's relationship would likely end, too. Still, it made Mary uncomfortable—not because she was a prude; she liked to think, despite her good-girl Catholic upbringing, that she wasn't. But rather because she was afraid Ponter might get the wrong idea about sexuality in this world, that he might think he was now *expected* to pair off with Mary. And the attention of a man was the last thing she wanted right now.

Still, Louise and Reuben's affair did mean that she and Ponter got a lot of time alone together. After a day, it had developed that Reuben and Louise would spend most of their time downstairs, in the basement, watching videos from Reuben's vast collection, while Mary and Ponter were usually together on the ground floor. And since Reuben and Louise were now sleeping together, they had reclaimed the queen-sized bed from Ponter. Mary didn't know quite what Reuben had said to manage the switch, but Ponter's new bed was the couch in Reuben's upstairs office, leaving the living room all to Mary.

Some Sundays, Mary went to mass. She hadn't gone this week—although she could have, since it wasn't until Sunday evening that the LCDC had ordered the quarantine. But now she was sorry she'd missed it.

Fortunately, there were masses on TV; Vision showed a Roman Catholic one broadcast from a church in Toronto every day. Reuben had a TV in his upstairs office, in addition to the set he and Louise were using in the basement. Mary went up to the office to watch the service being broadcast. The priest was dressed in opulent green vestments. He had silver hair but black eyebrows, and a face that made Mary think of a scrawny Gene Hackman.

". . . Grace and peace of our Lord, Jesus Christ, the love of God our Father and the fellowship of the Holy Spirit be with you all," pronounced the priest, a Monsignor DeVries, according to the title superimposed on the screen.

Mary, sitting now on the couch that tonight would serve as Ponter's bed, crossed herself. "Jesus was sent here to heal the contrite," announced DeVries. "Lord have mercy."

Mary joined the TV congregation in repeating, *"Lord have mercy."*

"He came to call sinners," said DeVries. "Christ have mercy."

"Christ have mercy," repeated Mary and the others.

"He pleads for us at the right hand of the Father. Lord have mercy."

"Lord have mercy."

"May Almighty God have mercy on all of us," said DeVries, "forgive our sins, and bring us to everlasting life."

"Amen," said the congregation.

The reading, by a black woman with short-cropped hair wearing a purple

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robe, was from the Book of the Prophet Jeremiah. Behind her, a beautiful stained-glass window depicted a haloed Jesus and the twelve Apostles, with the Virgin Mary looking on. Mary wasn't exactly sure why she'd felt the need to hear a Mass today. After all, she wasn't the one who needed forgiveness for sin . . .

Organ music was playing now; a young man sang, "Save me, O Lord, in Your steadfast love . . ."

Mary had done nothing wrong. She was the victim.

The Eucharist continued, with the Monsignor reading from Luke: "'Declare that these two sons of mine will sit one at Your right hand and one at Your left in Your kingdom . . . '"

Of course, Mary knew the story the priest was reciting of the woman who beseeched Christ on the road to Jerusalem; she knew the context. But the words echoed in her head: *two sons, one at Your right hand and one at Your left . . .*

Could it have been that way? Could two kinds of humanity have lived peacefully side by side? Cain had been an agriculturalist; he grew corn. Abel had been a carnivore, who raised sheep for slaughter. But Cain had slain Abel . . .

The priest was pouring wine now. "Blessed to You, Lord God of all Creation, through Your goodness we have this wine to offer. Fruit of the vine and the work of human hands, it will become a spiritual drink . . .

"Pray, brothers and sisters . . .

"God of power and might, we praise You through Your Son Jesus Christ, who comes in Your name . . .

"God our Father, we have wandered far from You but, through Your Son, You have brought us back . . .

"We ask You to sanctify these gifts through the power of Your spirit . . .

"Take this, all of you, and eat it. This is My body, which will be given up for you . . .

"Take this, all of you, and drink from it. This is the cup of My blood, the blood of the new and everlasting covenant. It will be shed for you and for all so that sins may be forgiven . . ."

Mary wished she could be with the congregation, taking Communion. When the ceremony was done, she crossed herself again and stood up.

And that's when she saw Ponter Boddit, standing quietly in the doorway, watching, his bearded, chinless jaw agape.

Chapter 33

"What was *that?*" asked Ponter.

"How long have you been there?" demanded Mary.

"A while."

"Why didn't you say anything?"

"I did not wish to disturb you," said Ponter. "You seemed . . . *intent* on what was happening on the screen."

Well, thought Mary, she had, in a way, usurped his room; the couch he slept on was the one she was now sitting on. Ponter came fully into Reuben's office and moved toward the couch, presumably to sit next to her. Mary scooted down to the far end, leaning against one of the couch's padded arms.

"Again," said Ponter, "what was that?"

Mary lifted her shoulders slightly. "A church service."

Ponter's Companion bleeped.

"Church," said Mary. "A, um, a hall of worship."

Another bleep.

"Religion. Worshiping God."

Hak spoke up at this point, using its female voice. "I am sorry, Mare. I do not know the meaning of any of these words."

"God," repeated Mary. "The being who created the Universe."

There was a moment during which Ponter's expression remained neutral. But then, presumably upon hearing Hak's translation, his golden eyes went wide. He spoke in his language, and Hak translated, using the male voice: "The Universe did not have a creator. It has always existed."

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Mary frowned. She suspected Louise—if she ever emerged from the basement—would enjoy explaining big-bang cosmology to Ponter. For her part, Mary simply said, "That's not our belief."

Ponter shook his head, but was evidently willing to let that go. Still: "That man," he said, indicating the TV, "talked of 'everlasting life.' Does your kind have the secret of immortality? We have specialists in life-prolongation, and they have long sought that, but—"

"No," said Mary. "No, no. He's talking about Heaven." She raised her hand, palm out, and successfully forestalled Hak's bleep. "Heaven is a place where we supposedly continue to exist after death."

"That is oxymoronic." Mary marveled briefly at Hak's proficiency. Ponter had actually spoken a dozen words in his own language, presumably saying something like "that's a contradiction in terms," but the Companion had realized that there was a more succinct way to express this in English, even if there wasn't in the Neanderthal tongue.

"Well," replied Mary, "not everyone on Earth—on this Earth, that is—believes in an afterlife."

"Do the majority?"

"Well . . . yes, I guess so."

"Do you?"

Mary frowned, thinking. "Yes, I suppose I do."

"Based on what evidence?" asked Ponter. The tone of his Neanderthal words was neutral; he wasn't trying to be derisive.

"Well, they say that . . ." She trailed off. Why *did* she believe this? She was a scientist, a rationalist, a logical thinker. But, of course, her religious indoctrination had occurred long before she'd been trained in biology. Finally, she shrugged a little, knowing her answer would be inadequate. "It's in the Bible."

Hak bleeped.

"The Bible," repeated Mary. "Scriptures." *Bleep.* "Holy text." *Bleep.* "A revered book of moral teachings. The first part of it is shared by my people—called Christians—and by another major religion, the Jews. The second part is only believed in by Christians."

"Why?" asked Ponter. "What happens in the second part?"

"It tells the story of Jesus, the son of God."

"Ah, yes. That man spoke of him. So—so this . . . this creator of the Universe somehow had a human son? Was God human, then?"

"No. No, he's incorporeal; without a body."

"Then how could he . . . ?"

"Jesus' mother was human, the Virgin Mary." She paused. "In a roundabout way, I'm named after her."

Ponter shook his head slightly. "Sorry; Hak has been doing an admirable job, but clearly is failing here. My Companion interpreted something you said as meaning one who has never had sexual intercourse."

"Virgin, yes," said Mary.

"But how can a virgin also be a mother?" asked Ponter. "That is another—" and Mary heard him speak the same string of words that Hak had rendered before as "oxymoron."

"Jesus was conceived without intercourse. God sort of planted him in her womb."

"And this other faction—Jews, you said?—rejects this story?"

"Yes."

"They seem . . . less credulous, shall we say." He looked at Mary. "Do you believe this? This story of Jesus?"

"I *am* a Christian," Mary said, confirming it as much for herself as for Ponter. "A follower of Jesus."

"I see," said Ponter. "And you also believe in this existence after death?"

"Well, we believe that the real essence of a person is the soul"—*bleep*—"an incorporeal version of the person, and that the soul travels to one of two destinations after death, where that essence will live on. If the person has been good, the soul goes to heav-

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en—a paradise, in the presence of God. If the person has been bad, the soul goes to hell"—*bleep*—"and is tortured"—*bleep*—"tormented forever."

Ponter was silent for a long time, and Mary tried to read his broad features. Finally, he said, "We—my people—do not believe in an afterlife."

"What *do* you think happens after death?" asked Mary.

"For the person who has died, absolutely nothing. He or she ceases to be, totally and completely. All that they were is gone forevermore."

"That's so sad," said Mary.

"Is it?" asked Ponter. "Why?"

"Because you have to go on without them."

"Do you have contact with those who dwell in this afterlife of yours?"

"Well, no. I don't. Some people say they do, but their claims have never been substantiated."

"Color me surprised," said Ponter; Mary wondered where Hak had picked up that expression. "But if you have no way of accessing this afterlife, this realm of the dead, then why give it credence?"

"I've never seen the parallel world you came from," said Mary, "and yet I believe in that. And you can't see it anymore—but you still believe in it, too."

Once again, Hak got full marks. *"Touché,"* it said, neatly summarizing a half-dozen words uttered by Ponter.

But Ponter's revelations had intrigued Mary. "We hold that morality comes from religion: from the belief in an absolute good, and from the, well, the fear, I guess, of damnation—of being sent to Hell."

"In other words," said Ponter, "humans of your kind behave properly only because they are threatened if they do not."

Mary tilted her head, conceding the point. "It's Pascal's wager," she said. "See, if you do believe in God, and he doesn't exist, then you've lost very little. But if you don't, and he does, then you risk eternal torment. Given that, it's prudent to be a believer."

"Ah," said Ponter; the interjection was the same in his language as hers, so no rendering of it was made by Hak.

"But, look," said Mary, "you still haven't answered my question about morality. Without a God—without a belief that you will be rewarded or punished after the end of your life—what drives morality among your people? I've spent a fair bit of time with you now, Ponter; I know you're a good person. Where does that goodness come from?"

"I behave as I do because it is right for me to do so."

"By whose standards?"

"By the standards of my people."

"But *where* do those standards come from?"

"From . . ." And here Ponter's eyes went wide, great orbs beneath an undulating shelf of bone, as though he'd had an epiphany—in the secular sense of the word, of course. "From our conviction that there is *no* life after death!" he said triumphantly. "That's why your belief troubles me; I see it now. Our assertion is straightforward and congruent with all observed fact: a person's life is completely finished at death; there is no possibility of reconciling with them, or making amends after they are gone, and no possibility that, because they lived a moral life, they are now in a paradise, with the cares of this existence forgotten." He paused, and his eyes flicked left and right across Mary's face, apparently looking for signs she understood what he was getting at.

"Do you not see?" Ponter went on. "If I wrong someone—if I say something mean to them, or, I do not know, perhaps take something that belongs to them—under your worldview I can console myself with the knowledge that, after they are dead, they can still be contacted; amends can be made. But in my worldview, once a person is gone—which could happen for any of us at any moment, through accident or heart attack or so on—then you who did the

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wrong must live knowing that that person's entire existence ended without you ever having made peace with him or her."

Mary thought about that. Yes, most slave owners had ignored the issue, but surely some people of conscience, caught up in a society driven by bought-and-sold human beings, must have had qualms . . . and yet had they consoled themselves with the knowledge that the people they were mistreating would be rewarded for their suffering after death? Yes, the Nazi leaders were pure evil, but how many of the rank-and-file, following orders to exterminate Jews, had managed to sleep at night by believing the freshly dead were now in paradise?

Nor did it have to be anything so grandiose. God was the great compensator: if you were wronged in life, it would be made up for in death—the fundamental principle that had allowed parents to send their children off to die in war after countless war. Indeed, it didn't really matter if you ruined someone else's life, because that person might well go to Heaven. Oh, you yourself might be dispatched to Hell, but nothing you did to anyone else really hurt them in the long run. This existence was mere prologue; eternal life was yet to come.

And, indeed, in that infinite existence, God would make up for whatever had been done to . . . to *her.*

And that bastard, that bastard who had attacked her, would burn.

No, it didn't matter if she never reported the crime; there was no way he could escape his ultimate judge.

But . . . but . . . "But what about your world? What happens to criminals there?"

Bleep.

"People who break laws," said Mary. "People who intentionally hurt others."

"Ah," said Ponter. "We have little problem with that any more, having cleansed most bad genes from our gene pool generations ago."

"What?" exclaimed Mary.

"Serious crimes were punished by sterilization of not just the offender but also anyone who shared 50 percent of the offender's genetic material: brothers and sisters, parents, offspring. The effect was twofold. First, it cleansed those bad genes from our society, and—"

"How would nonagriculturalists stumble onto genetics? I mean, we figured it out through plant cultivation and animal husbandry."

"We may not have bred animals or plants for food, but we did domesticate wolves to help us in hunting. I have a dog named Pabo that I am very fond of. Wolves were quite susceptible to controlled breeding; the results were obvious."

Mary nodded; that sounded reasonable enough. "You said the sterilization had a twofold effect on your society?"

"Oh, yes. Besides directly eliminating the faulty genes, it gave families a strong incentive to make sure none of their own members ran seriously afoul of society."

"I suppose it would at that," said Mary.

"It did indeed," said Ponter. "You, as a geneticist, surely know that the *only* immortality that really exists is genetic. Life is driven by genes wanting to ensure their own reproduction, or to protect existing copies of themselves. So our justice was aimed at genes, not at people. Our society is mostly free of crime now because our justice system directly targeted that which really drives all life: not individuals, not circumstances, but *genes*. We made it so that the best survival strategy for genes is to obey the law."

"Richard Dawkins would approve, I imagine," said Mary. "But you were speaking of this . . . this sterilization practice in the past tense. Has it ended?"

"No, but there is little modern need."

"You were *that* successful? No one commits serious crimes anymore?"

"Hardly anyone does so because of ge-

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netic disorders. There are, of course, also biochemical disorders that cause antisocial behavior, but those are eminently treatable with drugs. Only rarely does sterilization still need to be invoked."

"A society without crime," said Mary, shaking her head slowly in amazement. "That must be . . ." She paused, wondering how much she wanted to let her guard down, then: "That must be *fabulous*." But she frowned. "Surely, though, a lot of crime must go unsolved. I mean, if you can't figure out who did something, then the perpetrator must go unpunished—or, if he had a biochemical disorder, untreated."

Ponter blinked. "Unsolved crimes?"

"Yes, you know: crimes for which the police"—*bleep*—"or whatever you have for law enforcement, can't figure out who did it."

"There are no such crimes."

Mary's back stiffened. Like most Canadians, she was against capital punishment—precisely because it was possible to execute the wrong person. All Canadians lived with the shame of the wrongful imprisonment of Guy Paul Morin, who had spent ten years rotting in jail for a murder he didn't commit; of Donald Marshall, Jr., who spent eleven years incarcerated for a murder he, too, didn't commit; of David Milgaard, who spent twenty-three years jailed for a rape-murder he also was innocent of. Castration was the least of the punishments Mary would like to see her own rapist subjected to—but if, in her quest for vengeance, she had it done to the wrong person, how could she live with herself? And what about the Marshall case? No, it wasn't *all* Canadians who lived with the shame of that; it was *white* Canadians. Marshall was a Mi'kmaq Indian whose protestations of innocence in a white court, it seemed, weren't believed simply because he *was* an Indian.

Still, maybe she was thinking now more like an atheist than a true believer. A believer should hold that Milgaard, Morin, and Marshall were eventually going to receive their just, heavenly reward, making up for whatever they'd endured here on Earth. After all, God's own son had been executed unfairly, even by the standards of Rome; Pontius Pilate didn't think Christ guilty of the crime with which he'd been charged.

But Ponter's world was beginning to sound worse even than Pilate's court: the brutality of forced sterilizations with an absolute belief that you'd always correctly found the guilty party. Mary suppressed a shudder. "How can you be certain you've convicted the right person? More to the point, how can you be sure you *haven't* convicted the wrong person?"

"Because of the alibi archives," said Ponter, as if it were the most natural thing in the world.

"The *what?*" said Mary.

Ponter, still seated next to her on the couch in Reuben's office, held up his left arm and rotated it so that the inside of his wrist faced toward her. The strange digits on the Companion winked at Mary. "The alibi archives," he said again. "Hak constantly transmits information about my location, as well as three-dimensional images of exactly what I am doing. Of course, it has been out of touch with its receiver since I came here."

This time Mary didn't suppress the shudder. "You mean you live in a totalitarian society? You're constantly under surveillance?"

"Surveillance?" said Ponter, his eyebrow climbing over his browridge. "No, no, no. No one is monitoring the transmitted data."

Mary frowned, confused. "Then what's done with it?"

"It is recorded in my alibi archive."

"And what, exactly, is that?"

"A computerized memory archive; a block of material onto whose crystalline lattices we imprint unalterable recordings."

"But if no one is monitoring it, what's

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it for?"

"Am I misusing your word 'alibi'?" said Hak, in the female voice it used when talking on its own behalf. "I understood an alibi to be proof that one was somewhere else when an act was committed."

"Um, yes," said Mary. "That's an alibi."

"Well, then," continued Hak. "Ponter's archive provides him with an irrefutable alibi for any crime he might be accused of."

Mary felt her stomach flutter. "My God—Ponter, is the onus on *you* to prove your innocence?"

Ponter blinked, and Hak translated his words with the male voice. "Who else should it be on?"

"I mean, here, on this Earth, a person is innocent until proven guilty." As the words came out, Mary realized that there were many places where that, in fact, wasn't true, but she decided not to amend her comment.

"And I take it that you have nothing comparable to our alibi archives?" asked Ponter.

"That's right. Oh, there are security cameras in some places. But they're not everywhere, and almost no one has them in their homes."

"Then how do you ascertain someone's guilt? If there is no record of what actually happened, how can you be sure you are going to deal with the appropriate person?"

"That's what I meant about unsolved crimes," said Mary. "If we're not sure—and often we have no idea at all—then the person gets away with the crime."

"That hardly seems a better system," said Ponter slowly.

"But our *privacy* is protected. No one is constantly looking over our shoulders."

"Nor is anyone in my world—at least, not unless one is a . . . I do not know the word. Somebody who shows all for others to watch."

"An exhibitionist?" said Mary, raising her eyebrows in surprise.

"Yes. Their contribution is to allow others to monitor the transmissions from their Companions. They have enhanced implants that sense at a higher resolution and to a greater distance, and they go to various interesting places so that other people can watch what is happening there."

"But surely, in theory, someone could compromise the security of anyone's transmissions, not just those of an exhibitionist."

"Why would anyone want to do that?" asked Ponter.

"Well—um, I don't know. Because they can?"

"I can drink urine," said Ponter, "but never have I felt the urge to do so."

"We have people here who consider it a challenge to compromise security measures—especially those involving computers."

"That hardly seems a contribution to society."

"Perhaps not," said Mary. "But, look, what if the person who is accused doesn't want to unlock his—what did you call it? His alibi archive?"

"Why would he not?"

"Well, I don't know. Just on general principle?"

Ponter looked perplexed.

"Or," said Mary, "because what they were actually doing at the time of the crime was embarrassing?" *Bleep.* "Embarrassing. You know, something you are ashamed"—*bleep*—"of."

"Perhaps an example would help me get your meaning," said Ponter.

Mary pursed her lips, thinking. "Well, um, okay, say I was—say I was, you know, having, um, sex with someone else's mate; the fact that I was doing that might be my alibi, but I wouldn't want people to know it."

"Why not?"

"Well, because we believe adultery"—*bleep*—"is wrong."

"Wrong?" said Ponter, Hak having apparently guessed the meaning of the untranslated word. "How can it be, unless

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a claim of false paternity results? Who is hurt by it?"

"Well, um, I don't know; I mean, we, ah, we consider adultery a sin." *Bleep.*

Mary had expected that bleep, at least. If you had no religion, no list of things that didn't actually hurt somebody else but were still proscribed behaviors—recreational drug use, masturbation, adultery, watching porno videos—then you might indeed not be so fanatic about privacy. People insisted on it at least in part because there were things they did that they'd be mortified to have others know about. But in a permissive society, an open society, a society where the only crimes are crimes that have specific victims, perhaps it wouldn't be such a big deal. And, of course, Ponter had shown no nudity taboo—a religious idea, again—and no desire for seclusion while using the bathroom.

Mary shook her head. All the times she'd been embarrassed and ashamed in her life, all the times she was glad no one could see what she was doing: were they uncomfortable simply because of church-imposed edicts? The shame she felt over leaving Colm; the shame that prevented her from getting a divorce; the shame she felt over dealing with her own drives now that she had no man in her life; the shame she felt because of sin . . . Ponter had none of that, it seemed; as long as he was hurting no one else, he never felt uncomfortable over acts that gave him pleasure.

"I suppose your system might work," said Mary dubiously.

"It does," replied Ponter. "And recall that for serious crimes—those involving assaults on another person—there are usually at least *two* alibi archives available: that of the victim, and that of the perpetrator. The victim usually introduces his or her own archive of the event as evidence, and most of the time it clearly shows the perpetrator."

Mary was simultaneously fascinated and repelled. Still . . .

That night at York . . .

If images had been recorded, could she have brought herself to show them to anyone?

Yes, she said to herself firmly. Yes. She had done nothing wrong, nothing to be ashamed of. She was the innocent victim. All the pamphlets Keisha had given her at the rape-crisis center said that, and she really, really, really, really tried to believe it.

But—but even if there were a recording of what she'd seen, could it have been used to catch the monster? He'd been wearing a balaclava; she'd never seen his face—although a thousand different versions of it had haunted her dreams since. Who would she have accused? Whose alibi archive would the courts have ordered unlocked? Mary had no idea where to begin, no idea whom to suspect.

She felt her stomach flutter. Maybe that was the *real* problem—the predicament that Ponter's people had avoided: having too many possible suspects, too much crowding, too much anonymity, too many vicious, aggressive . . . ***men***, she thought. Men. Every academic of her generation had been sensitized to the issue of gender-neutral language. But violent crimes were indeed overwhelmingly caused by males.

And, yet, she'd spent her life surrounded by good, decent men. Her father; her two brothers; so many supportive colleagues; Father Caldicott, and Father Belfontaine before him; many good friends; a handful of lovers.

What proportion of men really were the problem? What fraction were violent, angry, unable to control their emotions, unable to resist their impulses? Was it so vast a group that it couldn't have been—*cleansed* was Ponter's word, a nurturing word, a hopeful word—from the gene pool generations ago?

No matter how large or how small the population of violent males was, thought Mary, there were too many.

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Even one such beast would be too many, and—

And here she was, thinking like Ponter's people. The gene pool *could* indeed use a good cleansing, a therapeutic purging.

Yes, it surely could.

Chapter 34

Adikor Huld lay in his bed, flush with the ground, staring up at the timepiece mounted on the ceiling. The Sun had been up for several daytenths now, but he couldn't see any reason to rise.

What had happened that day, down in the quantum-computing lab? What had gone wrong?

Ponter hadn't been vaporized; he wasn't consumed by flame; he didn't explode. All those things would have left abundant traces.

No, if he was right, Ponter had been *transferred* to another universe . . . but . . .

But that sounded outlandish even to him; he understood how outrageous it must have seemed to Adjudicator Sard. And yet, what other explanation was there?

Ponter had disappeared.

And a large quantity of heavy water had appeared in his place.

Presumably, thought Adikor, it had been an even exchange—identical *masses* transposed, but radically different *volumes*. After all, it wasn't just Ponter that had disappeared; Adikor had heard the air rushing out of the quantum-computing chamber, as if all of it, too, had been shunted to another place. But even a room's worth of air had little mass, whereas liquid water—even liquid *heavy* water—was in the most dense state of that substance, more dense even than the solid, frozen variety.

So: a large volume of air and one man had disappeared from this universe, and an identical mass, but much smaller volume, of heavy water had come through to replace it from . . . from *the other side;* it was the phraseology that kept coming to Adikor's mind.

But . . .

But then that meant that there was heavy water at this location in the other universe. And pure heavy water did *not* occur naturally.

Which meant the . . . the *portal*, another word that came unbidden . . . must have opened into a storage tank for heavy water. And if heavy water was transferred from there to here, then Ponter was transferred from here to there, meaning . . .

Meaning he'd quite likely drowned.

Tears filled Adikor's deep eye sockets, like rainwater gathering in wells.

Ponter shifted on the couch and looked again at Mary. "The alibi archives do not just solve crimes," he said. "They have many other uses. For instance, I saw on TV yesterday that two campers were lost in Algonquin Park."

Mary nodded.

"Being lost like that is impossible in my world. Your Companion triangulates on signals from various mountaintop transmitters to pinpoint your position, and if you are injured or trapped by a rock fall or something, it is easy for the rescue teams to home in on your Companion." He raised a hand, copying what Mary had done earlier, forestalling the objection he presumably saw coming. "Of course, only an adjudicator can order that you be tracked like that, and only when you request it by sending an emergency signal, or when a family member asks for it."

Headlines she'd seen all too frequently swirled through Mary's mind. "Police abandon search." "Hunt for missing girl called off." "Avalanche victims presumed dead."

"I guess an emergency signal like that *would* be useful," Mary said.

"It is," replied Ponter firmly. "And the Companion can issue the signal automatically, if you yourself are unable to. It monitors vital signs, and if you have a heart attack—or even are about to have

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a heart attack—it can summon aid."

Mary felt a twinge. Her own father had died of a heart attack, alone, when Mary had been 18. She'd found his body upon arriving home from school one day.

Ponter evidently mistook the sadness on Mary's face for continuing dubiousness. "And just a month before I came here, I misplaced a rain shield that I was very fond of; it had been a gift from Jasmel. I would have been"—*bleep;* devastated?—"had it been lost for good. But I simply visited the archive pavilion where my recordings are stored, and reviewed the last day's events. I saw exactly where I lost the shield and was able to retrieve it."

Mary certainly resented the countless hours she'd spent looking for misplaced books and student papers and business cards and house keys and coupons that were about to expire. Maybe you'd resent that even more if you were sure your existence was finite; maybe that knowledge would drive you to do something to avoid such wastes of time. "A personal black box," Mary said, really to herself, but Ponter responded.

"Actually, the recording material is mostly pink. We use reprocessed granite."

Mary smiled. "No, no. A black box is what we call a flight recorder: a device aboard an airplane that keeps track of telemetry and cockpit chatter, in case there's a crash. But the idea of having my own black box had never occurred to me." She paused. "How are the pictures taken, then?" Mary glanced down at Ponter's wrist. "Is there a lens on your Companion?"

"Yes, but it is only used to zoom in on things outside the Companion's normal recording space. The Companion uses sensor fields to record everything surrounding the person, and the person himself, as well." Ponter made the deep sound that was his chuckle. "After all, it would not be much good if we only recorded what was visible from the Companion's lens: lots of images of my left thigh or the inside of my hip pouch. This way, when playing back my archive, I can actually view myself from a short distance away."

"Amazing," said Mary. "We have *nothing* like that."

"But I have seen products of your science, your industry," said Ponter. "Surely, if you had made it a priority to develop such technology . . ."

Mary frowned. "Well, I suppose. I mean, we went from putting the first object in space to the first man on the Moon in less than twelve years, and—"

"Say that again."

"I said, when we wanted badly enough to put somebody on the Moon—"

"The Moon," repeated Ponter. "You mean *Earth's* Moon?"

Mary blinked. "Uh-huh."

"But . . . but . . . that is fantastic," Ponter said. "We have never done such a thing."

"You've never been to the Moon? I don't mean you personally; I mean your people. No Neanderthal has ever been to the Moon?"

Ponter's eyes were wide. "No."

"What about Mars or the other planets?"

"No."

"Do you have satellites?"

"No, just one, like here."

"No, I mean *artificial* satellites. Unmanned mechanisms you put into orbit, you know, to help in predicting the weather, for communications, and so on."

"No," said Ponter. "We have nothing like that."

Mary thought for a moment. Without the legacy of the V-2, without the missiles of the Second World War, would humans here have been able to send anything into orbit? "We've launched—well, I don't know—many hundreds of things into space."

Ponter looked up, as if trying to visualize Luna's scowling face through the

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ceiling of Reuben's house. "How many live on the Moon now?"

"None," said Mary, surprised.

"You do not have a permanent settlement there?"

"No."

"So people simply go to see the Moon, then return to Earth. How many go each month? Is it a popular thing to do?"

"Umm, nobody goes. Nobody has gone for—well, I guess it's thirty years now. We only ever sent twelve people to the Moon's surface. Six groups of two."

"Why did you stop?"

"Well, it's complicated. Money was certainly one factor."

"I can imagine," said Ponter.

"And, well, there was the political situation. See, we—" She paused for a moment. "Gee, this is hard to explain. We called it 'The Cold War.' There was no actual fighting going on, but the United States and another large nation, the Soviet Union, were in a severe ideological conflict."

"Over what?"

"Umm, over economic systems, I suppose."

"Hardly sounds worth fighting about," said Ponter.

"It seemed very important at the time. But, anyway, the president of the United States, he set the goal in—when was it?—in 1961, I guess, to put a man on the Moon by the end of that decade. See, the Russians—the people from the Soviet Union—they'd put the first artificial satellite in space, and then the first man in space, and the U.S. was lagging behind, so, well, it set out to beat them."

"And did it?"

"Oh, yes. The Russians never managed to put anyone on the Moon. But, well, once we'd beaten the Russians, the public pretty much lost interest."

"That is ridiculous—" began Ponter, but then he stopped. "No, I must apologize. Going to the Moon is a magnificent feat, and whether you did it once or a thousand times, it is still praiseworthy." He paused. "I guess it is simply a question of different priorities."

Chapter 35

Mary and Ponter headed downstairs, looking for something to eat. Just after they got to the kitchen, Reuben Montego and Louise Benoît finally emerged from the basement. Reuben grinned at Ponter. "More barbecue?"

Ponter smiled back at him. "Please. But you must let me help."

"I'll show you how," said Louise. She patted Ponter on the forearm. "Come on, big fella."

Suddenly, Mary found herself objecting. "I thought you were a vegetarian."

"I am," said Louise. "For five years now. But I know how to barbecue."

Mary had an urge to go with them, as Ponter and Louise headed out through the sliding glass doors onto the deck. But . . . but . . . no, that was silly.

Louise slid the glass doors shut behind them, keeping the cooled air inside the house.

Reuben was clearing off the kitchen table. He faked the voice of an old Jewish yenta. "So, vhat have you two kids been talking about?"

Mary was still looking out through the glass, at Louise, laughing and tossing her hair as she explained how the barbecue worked, and at Ponter, hanging on her every word.

"Umm, mostly religion," said Mary.

Reuben's voice immediately switched back to normal. "Really?"

"Uh-huh," said Mary. She tore her eyes away from what was going on outside, and looked at Reuben. "Or more precisely, Neanderthals' lack of religion."

"But I thought Neanderthals *did* have religion," said Reuben, now getting some plain white Corelle plates from a cupboard. "The cult of the cave bear, and all that."

Mary shook her head. "You've been reading old books, Reuben. No one

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takes that seriously anymore."

"Really?"

"Yeah. Oh, some cave-bear skulls were found in one cave that had indeed been occupied by Neanderthals. But it now looks like the bears had simply died in the cave, probably during hibernation, and the Neanderthals had moved in afterwards."

"But weren't the skulls all arranged in patterns?"

"Well," said Mary, getting a handful of cutlery and laying it out, "the guy who first found them claimed they were in a stone crib or coffin. But no photos were taken, workers supposedly destroyed the coffin, and the only two sketches made by the archeologist—a guy named Bächler—completely contradict each other. No, it seems Bächler simply saw what he wanted to see."

"Oh," said Reuben, now rummaging in the fridge for things to make a salad. "But what about Neanderthals burying their dead with stuff the dear departed might need in the afterlife? Surely that's a sign of religion."

"Well, it *would* be," said Mary, "if Neanderthals had really done that. But sites occupied for generations accumulate garbage: bones, old stone tools, and so on. The few examples we thought we had of grave goods at Neanderthal burials turned out to be stuff that had just accidentally been buried with the corpse."

Reuben was pulling leaves off a head of iceberg lettuce now. "Ah, but doesn't burial in and of itself imply a belief in the afterlife?"

Mary looked around for something else she could do to help, but there really didn't seem to be anything. "It might," she said, "or it might just be a case of trying to keep things neat. Lots of Neanderthal corpses are found in tightly wrapped fetal positions. That *could* be ceremony, or it could just be a desire on the part of the poor slob who had to dig the grave to make the hole as small as possible. Dead bodies attract scavengers, after all, and they get to stinking if you leave them out in the sun."

Reuben was now chopping up celery. "But . . . but I read about Neanderthals being, well, the first flower children."

Mary laughed. "Ah, yes. Shanidar Cave, in Iraq—where Neanderthal bodies were found covered with fossil pollen."

"That's right," said Reuben, nodding. "As if they'd been buried wearing flower garlands, or something."

"Sorry, but that's been discredited, too. The pollen was just an accidental intrusion into the grave, brought there by burrowing rodents or groundwater percolating through the sediment. It really does seem that Neanderthals had very little of what we'd call religion, or even culture in general."

"But—wait a minute! What about the Neanderthal flute! That was front-page news all over the world."

"Yeah," said Mary. "Ivan Turk found that in Slovenia: a hollowed-out bear bone with four holes in it."

"Right, right. A flute!"

"'Fraid not," said Mary, leaning against the side-by-side fridge now. "It turns out that the bone was pierced by carnivore gnawing—probably by a wolf. And, yes, in typical newspaper fashion, that revelation did *not* make the front page."

"That's for sure. This is the first I've heard of it."

"I was there at the Paleoanthropology Society meeting in Seattle in '98, when Nowell and Chase presented their paper discrediting the flute." Mary paused. "No, it really does look like right until the very end, Neanderthals—at least on this version of Earth—had nothing that we'd call religion, or even culture for that matter. Oh, some of the very last specimens show a little variety in the things they did, but most paleoanthropologists think they were just imitating Cro-Magnons who lived nearby; Cro-Magnons were indisputably our direct ancestors."

"Speaking of Cro-Magnons," said Reuben, "what about crossbreeding be-

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tween Neanderthals and Cro-Magnons? Didn't I read that fossils of a hybrid child had been found in, what, oh, maybe 1998?"

"Yeah, Erik Trinkaus is big on that specimen; it's from Portugal. But, look, he's a physical anthropologist, and I'm a geneticist. He bases his case entirely on the skeleton of a child that, to him, shows hybrid characteristics. But he doesn't have the skull—and the skull is the only truly diagnostic part of a Neanderthal. To me, it just looks like a stocky kid."

"Hmm," said Reuben. "But, you know, I've seen guys who look a fair bit like Ponter, in features if not in coloring. Some Eastern Europeans, for instance, have big noses and prominent browridges. Are you saying those guys don't have Neanderthal genes in them?"

Mary shrugged. "I know some paleoanthropologists who would argue that they do. But, really, the jury is still out on whether our kind of humans and Neanderthals even could crossbreed."

"Well," said Reuben, "if you keep spending so much time with Ponter, maybe you'll answer that one for us someday."

Reuben was close enough that she was able to swat him on the arm with an open hand. "Stop that!" she said. She looked into the living room, so that Reuben wouldn't see the grin growing across her face.

Jasmel Ket showed up at Adikor's house around noon. Adikor was surprised but pleased to see her. "Healthy day," he said.

"The same to you," replied Jasmel, bending down to scratch Pabo's head.

"Will you have food?" asked Adikor. "Meat? Juice?"

"No, I'm fine," said Jasmel. "But I've been reading more of the law. Have you considered a counterclaim?"

"A counterclaim?" repeated Adikor. "Against whom?"

"Daklar Bolbay."

Adikor ushered Jasmel into the living room. He took a chair, and she took another. "On what possible charge?" said Adikor. "She has done nothing to me."

"She has interfered with your grieving for the loss of your man-mate . . ."

"Yes," said Adikor. "But surely that is not a crime."

"Isn't it?" said Jasmel. "What does the Code of Civilization say about disturbing the life of another?"

"It says a lot of things," said Adikor.

"The part I'm thinking of is, 'Frivolous actions against another cannot be countenanced; civilization works because we only invoke its power over the individual in egregious cases.'"

"Well, she's accused me of murder. There's no more egregious crime."

"But she has no real evidence against you," said Jasmel. "That makes her action frivolous—or, at least, it might in the eyes of an adjudicator."

Adikor shook his head. "I can't see Sard being impressed by that argument."

"Ah, but Sard cannot hear the counterclaim; that's the law. You'd speak in front of a different adjudicator."

"Really? Maybe it *is* worth trying. But . . . but my goal isn't to prolong these proceedings. It's to get them over with, to get this rotting judicial scrutiny lifted so I can get back down to the lab."

"Oh, I agree you shouldn't really pursue a counterclaim. But the suggestion that you might could perhaps help you get your answer."

"Answer? About what?"

"About why Daklar is pursuing you like this."

"Do *you* know why?" asked Adikor.

Jasmel looked down. "I didn't, not until today, but . . ."

"But what?"

"It's not for me to say. If you're going to hear it at all, it will have to be directly from Daklar." ■

To be continued!

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THE REFERENCE LIBRARY Tom Easton

Look to Windward, Iain M. Banks, Pocket, $23.95, 369 pp. (ISBN: 0-7434-2191-4).

The Other Wind, Ursula K. Le Guin, Harcourt, $25, 246 pp. (ISBN: 0-15-100684-9).

Angelmass, Timothy Zahn, TOR, $27.95, 431 pp. (ISBN: 0-312-87828-1).

Picoverse, Robert A. Metzger, Ace, 22.95 , 400 pp. (ISBN: 0-44100899-2).

Adventures in Time and Space with Max Merriwell, Pat Murphy, TOR, $24.95, 287 pp. (ISBN: 0-312-86643-7).

Sir Apropos of Nothing, Peter David, Pocket, $23.95, 504 pp. (ISBN: 0-7434-1233-8).

Skin Folk, Nalo Hopkinson, Warner Aspect, $12.95, 260 pp. (ISBN: 0-446-67803-1).

Ground Zero, Fred Gambino, Paper Tiger, $29.95, 112 pp. (ISBN: 1-85585-891-6).

Visions of Spaceflight: Images from the Ordway Collection, Frederick I. Ordway, III, Four Walls Eight Windows, $50, 176 pp. (ISBN: 1-56858-181-5).

Roswell: Inconvenient Facts and the Will to Believe, Karl T. Pflock, Prometheus, $25, 331 pp. (ISBN: 1-57392-894-1).

One thing that keeps getting said about technology is that it relieves us of work and will someday lead to a life of leisure for all. That "someday" keeps moving ahead on us, for people always seem able to find new work to replace the old. But what will happen when we have artificial intelligence licked? When computers not only sort our address books but also make our appointments, book travel, manage cities, and even write book review columns? That is, when mere humans don't have a thing to do but goof off?

Some writers have moaned that we will promptly turn to mental, moral, and physical mush and die out—unless a hero manages to unplug the machine. Some have said we will turn into VR dreamers, or flee to the stars, or . . .

Iain Banks says it doesn't really matter whether a machine (in his case, a Mind, an AI with quite superhuman capabilities) can do something better than a human. People climb mountains even though a helicopter could get them to the top faster. It's the effort, the journey, the personal accomplishment that counts, not the end result—although the climber might be a bit pissed if greeted at the peak by a party of chopper-borne picnickers!

Banks's novels center on the Culture, where Minds take care of all the gritty little details of life and people can spend their time "playing." Whatever they do, from mountain climbing to art to politics, they do because they *want* to do it, not because they have to.

They also have the notion that their lifestyle is the Best of All Possible, and they want to push it a bit, which leads to the backstory for **Look to Windward**. They meddle in the cultures of other sentients, such as the Chelgrians, whose hidebound caste system really did seem due for change. Unfortunately, that meddling has led to civil war, the deaths of billions, and the presence of dissident Composer Ziller on Masaq'Or-

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bital, a Culture ringworld. Not that the billions of dead represent any record—eight centuries past, a larger war ended when the Idirans novaed two suns in a last-ditch attempt to ward off the Culture.

The Culture feels guilt. This is why Masaq's Mind is orchestrating a memorial for the Idiran disaster, gathering groups to reflect as the light of the first nova dawns above their heads. It is also commissioning Ziller to create a symphony to perform when the second nova's light blooms in the sky.

But word has arrived that the Chelgrians are sending an emissary to talk to Ziller, perhaps to urge him to return home, perhaps to assassinate him. Ziller refuses to meet with him, despite the entreaties of drone (AI robot) E. H. Tersono and Homomdan (alien) Kabe Ischloear.

The Chelgrian emissary is Quilan, a war-hero utterly grief-stricken by the loss of his wife, wanting nothing but death. He *thinks* he's supposed to talk Ziller into coming home to Chel, but he knows that he has a secret and horrific agenda, its details timed to emerge into memory only as he needs them. He also has a resident sidekick—a retired military officer—in his brain-implant backup device.

The details emerge slowly, while Banks examines the way Culture citizens "play" instead of "work," aliens reflect on whether Culture citizens are weak and decadent, and Chel explicates its need for revenge. And in the end, when all comes together, there is as well some thought on just how "human" a powerful AI might be.

Banks is consistently readable, thought-provoking, and entertaining. This one does not hurt that rep a bit.

Ursula K. Le Guin is among the very best of writers, thoughtful, deft, warm, and seminal. Among her most popular works are the books of the Earthsea series, which began thirty years ago as a trilogy (*A Wizard of Earthsea*, *The Tombs of Atuan*, and *The Farthest Shore*), added a "last" book, *Tehanu*, in 1990, tacked on a collection of stories, *Tales from Earthsea* in 2000, and now appends **The Other Wind**—which looks like it just may be the real end of the tale.

Wind begins very simply, as Alder comes to Gont to visit Ged, the one-time master wizard of the archipelago that is Earthsea. Alder is a much smaller wizard, a mere mender, but he has a large problem: He mourns his dearly beloved wife, and he dreams of the land of the dead, where she and others plead with him to disassemble the low stone wall that bars the way between life and death. These dreams are incessant; he can barely sleep. He has been to Roke, the wizards' isle, but they sent him to Ged. And now Ged, who has no power but that of wisdom, gives him a kitten—living contact seems to help—and sends him on to the king.

The king, Lebannen, has his own problems. Dragons are laying waste the western islands of the kingdom. A Kargish warlord has sent his princess daughter as a bride; Lebannen is furious, but as Ged's wife, Tenar (once of Karg herself), coaches the princess in language and manner, that may ease. There are also hints that the princess's knowledge may help, for her people believe that the dead do not go to some land of shades but are reincarnated, that ages ago there was a division between dragons and humanity, and that the wizards of the west have violated the terms of that division.

Alder and his problem add a perspective that leads to a solution, but I will say no more other than that Harcourt's blurbery about the dead invading the land of the living is misleading. Le Guin is more subtle than that, and her theme here is not war between life and death but the appropriateness of clinging to life beyond its proper end.

That theme has come up before in the

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series. Here, Le Guin is saying that visions of afterlife (Hades, Heaven, Hell, Valhalla, all . . .) are desperate, greedy visions that defy the natural order. Far better it is to let go and move on.

Timothy Zahn's **Angelmass** is a nice, conventional action-adventure untouched by real physics or realistic characterization. The premise is that the Empyrean realm has seceded from the rest of human space, which is ruled by Earth's Pax Comitus, run by the money-grubbing accountants known as Adjutors. The Empyreans have a gimmick: a small black hole (Angelmass) that emits unusual particles, known as Angels. Properly packaged and hung about the necks of senators and bureaucrats, they seem to impel ethical behavior. The Pax says the Empyreans have been invaded and conquered by insidious aliens and must be rescued. The accountants insist that as little damage to infrastructure be done as possible. To that end, they have constructed a colossal warship, the *Komitadji*, which has so far done a fine job of scaring wayward colonies into toeing the line. But not the Empyreans. They have a nifty technology that can pitch even the *Komitadji* lightyears out of the way.

So the Pax is sending a spy: Jereko Kosta, a young academic, is snuck in with orders to study the Angels. Having no idea that he is a pawn intended for sacrifice, he takes his job seriously, gets into a good position for research, and begins to discover new things about the Angels.

Meanwhile, a young con artist on the run from her abusive lover crosses his path on the way to a safe niche with a pair of Angel-hunters. In due time, Jereko winds up with the trio as Angelmass starts showing signs of sentience and the Pax launches its final invasion.

All ends well, of course, along with a final homily that ethics is up to us. Not even impossible particles can break the "There ain't no such thing as a free lunch" rule.

* * *

A 21st century leap from the physics lab into the multiverse that only Gregory Benford, Philip José Farmer, and A. E. Van Vogt could have written—if they had ever collaborated.

Robert A. Metzger's **Picoverse** begins at Georgia Tech, that helluva wreck, where a team of physicists is putting together a "Sonomak," a would-be fusion generator considerably smaller than a tokomak. Unfortunately, government funding is flying south. The team, led by the arrogant Horst Wittkowski, must push the Sonomak past the limits of its design in order to pull in black funding. Unfortunately, Dr. Katie McGuire has simulation results that say they shouldn't do that. Fortunately, their son Anthony is a four-year-old hypergenius with a gift for constructing elaborate boobytraps of string, construction paper, and rubber bands. Unfortunately, the black funders, led by the evil-looking Quinn, don't like the project—or are they just goading Horst to pull out the stops?

And the Sonomak works. Not in the way Horst wishes, but in a weird fashion that sees the project vanish into a top-secret hole while we learn that Quinn's mistress, Alexandria, has a mission of her own. She is a tool of the Makers who created the story's universe, and she wants to escape their control. She plans to do so as soon as the Sonomak creates a new universe for her, the picoverse of the title.

Now meet Jack, a second-rate physicist—with well-hidden depths—brought in to monitor the project for Quinn and Alexandria. Soon he is on good terms with Katie and Anthony, and when the picoverse proves to contain a grown-up Anthony, he's right in the thick of things.

And those "things" are a complex mixture of created universes, cosmic scheming, and hidden implications that may lead to more than one sequel.

Pat Murphy has been having fun. First

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she gave us *There and Back Again by Max Merriwell*, a "translation" of *The Hobbit* into space opera that was a good deal of fun; one of its elements was the Trancers, who generated music that could make one dance willy-nilly. Max, the putative author, was supposedly a renowned SF writer who also wrote fantasies under a penname, such as Murphy's next, *Wild Angel by Mary Maxwell by Max Merriwell*, which concerned an orphan girl raised by wolves and featured a sheriff named Patrick Murphy and a weird brotherhood of Clampers, given to drink, revelry, and absurdity. Max's third penname is Weldon Merrimax, under which he writes bleak mysteries.

Murphy never gave us a Weldon Merrimax novel, but she hardly needed to. Her game is recursive and self-referential, and she takes it to the max with **Adventures in Time and Space with Max Merriwell**, which begins as newly divorced Susan Galina and her friend Pat Murphy board a cruise ship. Susan is searching for her stateroom when she runs into Max Merriwell arguing with the Cruise Director over whether he is or is not Weldon Merrimax (whom the CD thinks he hired to teach a writing workshop aboard the cruise). Before long, Max is getting ominous hexagrams and notes slipped under his door. Weldon himself shows up, as does Mary Maxwell, and their handwriting on bar tabs seems very similar to that on the notes. Sheriff Pat Murphy puts in an appearance but quickly vanishes, perhaps murdered by Weldon. He is soon followed by a pataphysician, a pack of wolves (aboard a cruise ship?), a flying saucer, a giant squid, a band with Trancer talents, the Clampers, and Mary Maxwell's favorite drink, the Flaming Rum Monkey (complete with recipe; see p. 178).

What the heck is going on? Has the world gone mad? Has the One who dreams the world begun to mix His own dreams with those of His creations? Have the barriers between alternate worlds developed leaks? It hardly matters. The book is a paean to the potentialities of imagination, foaming quantum uncertainties, and the sheer plasticity of human reality. It is also a warm and loving tale that makes one dearly wish Pat Murphy (both author and character), Susan Galina, Max Merriwell, and Tom Clayton (the ship's security chief, who becomes quite friendly with Susan) were all among one's circle of friends. Alas, their paper shadows will have to content us while we wait for Pat Murphy (the author) to come up with something new.

Peter David has a history of writing comics (*The Incredible Hulk*), TV (*Babylon 5*, etc.), Star Trek novels (*Imzadi*, etc.), and fantasy. His latest is **Sir Apropos of Nothing**, an amusing tale of a lad who was conceived when a party of "noble" knights raped a tavern wench. The poor girl, well tipped as well as tupped, realized there was money to be made on her back and promptly turned professional. The boy, dubbed Apropos by the midwife when he quite suitably bit the innkeeper who wanted to expose him for his deformed leg, grew up thinking whoredom perfectly natural, at least until the other kids set him straight. Nonetheless, Mom was Mom, and when a wandering soldier did her in, he craved justice. So it was off to the king's court, where his insouciant manner earned him a position as squire to the decrepit Sir Umbrage of the Flaming Nether Regions.

And a date with destiny as well. His mother always said he had one. She knew it, for she had seen a phoenix in the forest. And the king's throne room had a phoenix tapestry. So as soon as Apropos survived the taunting of the other squires and killed a knight, he was assigned the job of fetching the princess from the nunnery tasked with teaching her not to stick pens in tutors. All is going well, but then the Harpers Bizarre

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(mutant offspring of harpies) interfere, and despite his strong inclination to look out for number one first and foremost, Apropos finds himself clinging to destiny's neck.

The book's a nice fast read, well illumined by David's sly sense of humor which insists not only on strange names and puns, but also on sprinkling Apropos with malapropisms (as when David says a character's forest hideaway lends him a certain "cache" instead of "cachet," for instance).

Enjoy.

Nalo Hopkinson has earned grand plaudits for her novels, *Brown Girl in the Ring* and *Midnight Robber*. **Skin Folk** shows that she shines at shorter lengths, too. Here are fifteen quirky and insightful tales, many of them wry takes on classic folk tales. "Riding the Red" is a very strange version of you know what. "Precious" transplants the maiden whose every utterance spills as jewels and blossoms from her lips into the modern world; she's got problems! Many of the rest share the strong Caribbean flavor of the novels: for instance, "Greedy Choke Puppy" gives the Caribbean version of a vampire; unfortunately, her Granny knows what's going on.

If you enjoyed the novels, don't let this slip past. If you missed the novels, let *Skin Folk* show you why you should run out and buy them.

Is there any other genre of popular literature besides SF whose illustrators regularly get displayed in coffee-table books? Perhaps not, for SF is a very image-oriented genre, and I love the art books that come my way partly because they give me a chance to immerse myself in those images. If you're a fan, they can also serve as reminders of favorite books or artists or provide additional interpretations of works you've seen treated by other artists. If you're an artist (budding or bloomed), they can provide examples and tips that may be quite valuable.

So here's the latest: Fred Gambino is an SF illustrator working chiefly in the United Kingdom, where he has done marvelously three-dimensional work for books by David Brin, Lois McMaster Bujold, Elizabeth Moon, Harry Turtledove, and many more. **Ground Zero** showcases his work, with notes on technique (he has prowled supermarkets for interestingly shaped packaging he can dismember and construct into futuristic hardware that can serve as models for his paintings) and appreciative essays by several of the writers he has illustrated. He has a talent for composition and the visually striking.

A whole 'nother kind of art book takes a historical approach to a topic, tracking style and imagery across the years and even the centuries. **Visions of Spaceflight: Images from the Ordway Collection** looks all the way back to the eleventh century for an item from the Persian *Shah-Nama*, in which eagles bear a king to the Moon. Many later images are more familiar (Cyrano de Bergerac's bottled dew, Verne's cannon, Wells's Martians), until in more recent times the dreams of Tsiolkovsky, Goddard, and Von Braun grace the pages.

It seems a bit quaint to end with Von Braun, but the space stations and Mars missions dreamed in the fifties and sixties still have not been realized, and NASA's plans are still struggling to regain the same level of ambition. The torch was handed to SF and other "unofficial" dreamers. It is thus edifying to note how many images from half a century ago remain alive in SF.

"Belief is no substitute for critical thinking."

If you are religious, dead against genetic engineering of the food supply, or convinced that UFOs are flying saucers and alien bodies have been stored in government freezers for the last half

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century, that statement has to be offensive. It doesn't matter who said it. It could have been philosopher Daniel Dennett (*Darwin's Dangerous Idea*) or atheist biologist Richard Dawkins.

Or Karl T. Pflock, who has examined the Roswell phenomenon in **Roswell: Inconvenient Facts and the Will to Believe** and concluded that no flying saucer crashed in Roswell, New Mexico, in 1947. Interestingly, he began as something of a believer himself. But as he delved into the "evidence," he found numerous problems. Testimony was rife with lies, inconsistencies, and contradictions. Dates didn't match. The weather wasn't what people said it was. And many "witnesses" appear to have been trying to hop on a bandwagon for fame and fortune.

Pflock builds a good case. He begins with the supposed events themselves, and here he provides a very good primer for anyone who would like to know a little more about the "Roswell incident" (such as any SF writer who has admitted to writing the stuff and immediately been hit with "Do you believe in flying saucers? What about Roswell?"). He then starts checking facts, and by the time he is done, any critical thinker must agree that the Roswell incident is at best a modern myth or urban legend.

Confirmed saucer nuts, of course, will now say that Pflock is obviously part of the government cover-up conspiracy, wears a black suit, is chauffeured around the country in a black helicopter, and so on.

Not that there wasn't a cover-up—there really was a secret government project that generated debris for folks to misinterpret—but I'll let Pflock tell you about that and how government representatives generated a certain amount of deliberate confusion that helped the myth along. ■

Human alterations of the environment do not (yet) compare with such feats of nature as the moving of a continent or even the creation of the world. But we have been at it for a very short while.

—Michael Bell

DEPARTMENT OF LOFTY ASPIRATIONS

Does the fact that observations suggest the universe will continue expanding forever, growing even cooler and more diffuse, mean that all life must ultimately perish? Or could physical immorality still be achieved through advanced and ingenious intelligence?

(From a magazine premium notice received in the mail)

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BRASS TACKS

Dear Stan:

Your editorial "Immortality for Whom?" in the October issue has illuminated the mystery of why Dr. Frankenstein did not resurrect the woman he loved after she was killed by the monster in Mary Shelley's novel. He knew that reanimating her body would not restore her fundamental identity, because the monster himself lacked the memories of the people whose corpses had provided his parts. However, the nature of human identity remains an unsolved scientific problem, despite the many different schools of thought that offer partial answers.

To a behaviorist, you really are nothing more than the effects you create in the world, and to a logical positivist, speculations about your fundamental nature are meaningless. A biological reductionist might say that you are a whole society of entities, from the swarms of mitochondria that exist symbiotically within each of your cells, to the billions of neurons and glia in your skull whose relationships somehow sustain your memory and personality.

Philosophers relish the paradoxes: "This is my grandfather's axe. My father replaced the handle, and now I have replaced the head. So, is this really my grandfather's axe? When I go to sleep at night, perhaps I really die, to be replaced in the morning by a different being that possesses only a few of my memories." The existentialists brooded, "Suicide is the ultimate act of freedom, but who exactly gets liberated by it?" One of them complained to God, "I did not ask to be born!" God replied, "Who did not ask to be born?"

The first scientific approach to the problem of identity may have been when nineteenth-century psychiatry suggested that insanity mitigated moral responsibility, immediately colliding with cherished religious beliefs. If disease, injury, and old age can rob a person of memories, abilities, personality, and moral responsibility, how could a person have an immortal soul? (See Isaac Ray, *Treatise on the Medical Jurisprudence of Insanity*, 1871.)

Science fiction has often engaged these issues. *The World of Null-A* by A. E. van Vogt, originally published in *Astounding/Analog*, is based on the General Semantics theories of Alfred Kozybski, that hold it is a fallacy to say you are at all the same person you were yesterday. This is the fundamental issue that plagues the protagonist, Gilbert Gosseyn (go-sane, the opposite of go-crazy), who dies, is resurrected, then wonders who he really is.

Science fiction has offered many parascientific ideas about how identity could be passed from you to your clone (genetic duplicate) or to your cyclone (cybernetic clone). In *The Corsican Brothers*, by Alexandre Dumas père, identical twins share a telepathic bond. In the Dune series by Frank Herbert (which began in *Analog*), the ghola (ghoul or golem) of Duncan Idaho is constantly being regrown from fragments of his flesh, and recovering memories of his previous life in moments of epiphany.

If we can't resolve the problem of identity objectively, we can imagine a wide range of beliefs about it that future

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societies might have. If clones, cyclones, and gholas become commonplace, what kind of religion, psychiatry, or family structure would a society have? Get busy, science fiction writers!

William Sims Bainbridge, Ph.D.

Dear Dr. Schmidt:

The October 2001 *Analog* came to me via my old address in Belgium, so I may be a bit late in commenting on your editorial on "Immortality for Whom?" Still, I have a couple of questions about the concept of identity (the core issue in your piece) which I wanted to raise.

The first is, at what point does an individual stop being that individual? You discuss the case of a total, rapid transformation, but what if the transformation took place gradually over time? We already have artificial body parts of various types available, most recently including artificial hearts. As we grow older, all of us (or at least those with access to advanced medical care) are likely to have a number of parts replaced. In years to come, the replacements are likely to be artificial duplicates or animal substitutes to avoid the complications associated with donated human organs. At what point in this replacement process are we no longer ourselves? When more than 50 percent of our body has been replaced? When some key part such as the brain is replaced? It's going to make an interesting court case some day.

The second question is, if the new duplicate is exactly the same in all physical characteristics as the old original, what difference does it make? You point out that a copy of a software program is not the same thing as the original from which it was copied, but if they both operate in the same way does it matter? If I was able to present you with two robots, physically identical to each other with identical programming, would it matter which one came first off the assembly line? Unless I am missing something (quite possible), if the new cloned duplicate or other technological replacement for an aging human original is the same as the original in all physical characteristics that we can test, then the only difference would be something nonphysical, such as a soul. It is possible, of course, that something like the soul exists, but until its existence can be scientifically proven, I would have difficulty accepting that there is an essential difference between an original and his or her perfect duplicate.

Thanks for the mental exercise, and keep up the good work!

Colin Helmer

It doesn't make any difference to anyone else, but it does to the original—which was the point of my title. But you're right that a gradual transformation could make a significant difference to the conclusion.

Dear "Brass Tacks":

October's editorial raises important philosophical and theological questions. Granting Judeo-Christian-Muslim afterlife (heaven or hell) or Hindu-Buddhist reincarnation, the same questions of "transfer" vs. "copy" apply. Your "personhood" is copied to a new body (reincarnation) or into an alternate universe (heaven or hell). In 1 Corinthians 15: 36ff., St. Paul more or less explicitly states this. (Never mind that his botanical analogy is now known to be inaccurate: science catches up with more recent authors even now).

I remember a story from several decades ago (I think the title was "The Four Sided Triangle" or something like that; I forget the author) about two men, each "in love" with the same girl, so they ran her through an object duplicator. Each (original and copy) emerged thinking she was the original and the other the copy! Is a copy a continuation of the original? In the case of that story, subsequently each would have different experiences and thus diverge, but they would have the same past and it could be argued that either one was the con-

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tinuation of the original (or that both were!).

Stuart-Morgan Vance

Stanley Schmidt:

Your editorial in the October 2001 *Analog* investigating immortality by copying made some excellent points. I've long felt that "Beam me up, Scotty" is a request to be executed.

However, it seems to me that the question of continuing existence of the original after copying depends on whether memory is continuous during the process, which in turn depends on whether the copy is made in one step or piecemeal. Your editorial was about the one-step copying. But I can think of ways to do the copying piecemeal.

Let's say I have a computer-adjunct to my brain, and that it is as powerful as my brain. I then think with both brain and adjunct, so my thoughts and memories are continuously, and in real time, in both. Then suppose my brain deteriorated, as brains do, and eventually I got tired of its inefficiency and disposed of it. I'd be continuing, and wouldn't have died.

Or let's have a copier that makes a copy piecemeal while I am conscious, destroying bits as it copies them into a computer or clone or even other animal. I'm aware of continuing memory all through the process.

A form of piecemeal replacement is happening now, and has been all my life. Brain cells wear out and are discarded, but since they are replaced bit by bit rather than all at once, I continue. Or if we say that the earlier me has died, then that has happened many times, and since the current copy has the memory of the earlier ones, I don't know the difference.

This gets more complicated when more than one copy is made. If we use a piecemeal method to make several copies at the same time, then is only one the original, or are all of them?

J. A. Coffeen

***

Dear Dr. Schmidt:

I have just finished reading the October issue and I have been inspired to conceive two thoughts that I cannot resist sharing with you.

Your editorial essay, "Immortality for Whom?," is an excellent meditation on the nature of consciousness, but you missed one of the best thought experiments ever devised on the subject: Hans Moravec's neuron-by-neuron replacement scheme. I don't remember where I read it, but I recall the procedure well enough to describe it.

Suppose that I want to transfer my consciousness into a robot (think of "The Colossus of New York" if you want a suitably cheesy image to keep in mind, although that movie involved a brain transplant rather than a brain replacement). Because the process involves brain surgery, I can remain conscious throughout the procedure and observe what the process does to my consciousness. What the surgeon will do is create an electronic neuron that mimics as precisely as possible the behavior of a neuron in my brain. The surgeon connects it to all of the synapses to which the natural neuron is connected. When the natural neuron goes quiescent, it is removed and the artificial neuron is turned on. This is done for every neuron in my brain.

Now suppose that the particular neuron that was just replaced is essential to my memory of my office's telephone number. The surgeon hands me a telephone and says, "This will take some time. Perhaps you should call your office and tell your supervisor that you will be delayed?" Because the artificial neuron works just like the original did, I recall the number and make the call.

The procedure continues until my natural brain has been replaced by an electronic replica. During the procedure, I answer questions put to me by the surgical team to assure them that all aspects of my memory are intact. Yes, I

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can still integrate sinxdx (cos x). Yes, I can still balance a chemical reaction (you need two moles of hydrogen for every mole of oxygen if you want to create water, unless you're firing a Space Shuttle Main Engine, in which case adding a little extra hydrogen improves the specific impulse): it's not only my memory for facts that's intact, but also my ability to work them into various associations. Yes, I can still recall where my stepfather took my brother and me in the summer of '56 (Yosemite, and I also recall the awe that came over me when I saw an illustrated lecture on the geological history of the valley): my emotional memory is intact as well. Those questions and answers are merely ripples on a continuous stream of consciousness that is also following the procedure (Have they replaced my hippocampus yet? My amygdala?). There doesn't seem to be any opportunity here for the original me to die and be replaced by an alternate me.

The next step, shifting the artificial brain's nerve connections from my natural body to the robot, also seems inopportune for my death. Yes, I will experience some confusion. I will have double vision for a time and for a time I will be unable to locate sounds accurately. Certain parts of my body will seem to go numb and then reawaken. When the procedure is complete and the robot sits up on its slab, it will be the original me that looks out of robotic eyes and gazes, with a twinge of sadness, upon the empty vessel that has served me well and faithfully for over half a century. That's Moravec's hypothesis and I am inclined to believe it.

If we want to take the point of view that you expressed in your editorial, we might ask whether the Moravec process might run afoul of some kind of lethal blindsight (using something like the original meaning of lethal; that is, related to the effect of drinking from the River Lethe). We know that if we hypnotize a person and tell them that a certain chair does not exist, and if we then send that person down a path blocked by that very chair, they will avoid the chair as they walk down the path and later will swear upon all that is holy that they walked a straight path with no detours because they saw no obstacles in the path. Well, clearly some part of that person's mind did not register the presence of the chair and that part of the mind is, at least partly, the phenomena that we typically call the little movie that runs inside our heads. The chair did not appear in the person's inner movie, so it is not available to be recalled from memory and the person fills the gap with a false memory of having walked a straight line.

This may simply reflect my own ignorance of neurophysiology, but perhaps it's possible that something in the difference between the compositions of the natural and artificial neurons makes them just incompatible enough to bring on blindsight. I can't think of a mechanism for such a failure of the Moravec process, but let's assume that information encoded in the electronic neurons replacing my natural ones is unavailable to my inner movie. As the replacement of my natural brain progresses, fewer and fewer images are available to my inner movie. I can still answer questions from the surgical team, just as the person above avoided the chair, but the images associated with the answers do not appear in my inner movie. Eventually perceptions also become unavailable. I can no longer see the operating room or hear the questions, though the surgical team continues to get correct answers. Even knowledge of my body's internal states is no longer available to me. When the inner movie thus goes totally blank, I would have to say that I have ceased to exist. The thoughts that used to appear in the little movie inside my head subsequently appear in the little movie running inside someone else's head. That someone else may be an exact replica of me, but it's not the original me.

What I would like to see in this regard

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is a fact article written by Professor Moravec, in which he describes his process in all suitable detail and confronts the question of lethal blindsight. *That* would be an interesting read.

Dennis Anthony

Dr. Schmidt,

I have been looking through some back issues of *Analog* recently; one was April 1992. The editorial in that issue was "E Pluribus Zero." In it, you denounced what was than a growing demand for delivery of government services in languages other than English.

You noted that to serve every language would be extremely costly.

Mr. Schmidt, are you aware of Executive Order 13166?

This EO was issued by President Clinton, and it requires any organization supported by Federal funds to provide services in any language that any client wants or needs.

And yes, the cost burden is enormous.

Richard Rostrom

No, I wasn't aware of this. Can anyone else confirm, deny, or elaborate on effects?

Dear Stan,

I realize you are busy, but do you ever think about stopping by the Forum of *Analog* to see how things are going? Gardner is very active over at the *Asimov's* Forum, and it seems to help keep things lively when everyone knows he is watching. . . . I kind of view both magazines as one big family. Many Forum contributors are active at both sites and probably submit stories to both magazines. We would love to have you among us in the *Analog* Forum, even if you could only spare the occasional comment. If you just don't have time or feel it is better spent actually editing, I understand. Maybe your column is sufficient for the things you want to say. The most important thing is a quality magazine. By thw way, thanks for the good work over the years.

Gil Gregg

Actually, I do stop by the Forum fairly often to sample what's happening there, and may sometimes post a comment—but usually time just doesn't permit. Gardner and I both like to stay in close touch with our readers, but we each have our own preference about how to do it. He spends a lot of time online but doesn't write editorials or run a letter column; I do the opposite. I value the Forum as a source of additional feedback and as a place where readers can talk to each other without the long delays inherent in "Brass Tacks," but there is (as I predicted back before we even had an e-mail address) a lot more there than I can respond to directly.

However, if I see a lot of attention being given to some topic there, my reaction sometimes winds up in an editorial or a response to a letter expressing similar views. Which leads to me to a counter-suggestion for all you Forum-frequenters. I think most people who hang out on the Forum also read the magazine, but the reverse is less true. I've observed recently that some of the best discussion of stories, articles, and real events shows up on the Forum, but in the form of dialogs that print-only readers will never see because they don't lend themselves to simply pulling out and printing the whole thread. So when a good discussion has taken place on the Forum, I—and the other readers of the magazine—would really appreciate it if one or more of the participants would pull the gist of it together in a letter that we can *print in Brass Tacks.*■

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UPCOMING EVENTS Anthony Lewis

22–24 March 2002
MIDSOUTHCON (Mid-South SF conference) at Holiday Inn Select Hotel, Memphis, TN. Guest of Honor—C.J. Cherryh; Artist Guest of Honor—Tom Kidd; TM—Cullen Johnson. Registration—$30 until 1 March 2002, $35 at the door. Info—Midsouthcon, PO Box 11446, Memphis, TN 38111; URL—midsouthcon.org, phone—(731)664-6730

29 March–1 April 2002
HELICON 2 (British EASTERCON) at Hotel de France, St Helier, Baliwick of Jersey, Channel Islands. Guests—Brian Stableford, Harry Turtledove, Peter Weston. Registration—US50/GBP30/EUR50 (checks to Helicon 2). Info—Helicon 2, 33 Meyrick Drive, Wash Common, Newbury, Berkshire RG14 6SY, UK; email—helicon2@smof.demon.co.uk; URL—www.smof.demon.co.uk/helicon2.htm

5–8 April 2002
WILLYCON 2002 (Nebraska SF conference) at Wayne State College, Wayne NE. Theme—The "Science" of Science Fiction. Guest of Honor—James P. Hogan; Artist Guest of Honor—Terese Nielsen. Registration—$15, email—scifict@wscgate.wsc.edu; URL—www.wsc.edu/student/activities/clubs/sf-club/willycon

29 August–2 September 2002
CONJOSE (60th World Science Fiction Convention) at Convention Center, et al., San Jose, CA. Guests of Honor—Vernor Vinge, David A. Cherry, Bjo & John Trimble; TM—Tad Williams. Registration—$140 until 10 July 2002, more thereafter. (These are the latest rates posted on the Internet as of the time this column went to press.) This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—ConJose, Box 61363, Sunnyvale, CA 94088-1363; email—info@conjose.org; URL—www.conjose.org

Convention runners: If your convention has a telephone, FAX, email, or Web page URL, please let us know so that we can publish this information.

Convention attendees: When calling conventions for information, do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information; include an IRC if the convention is in a different country.■

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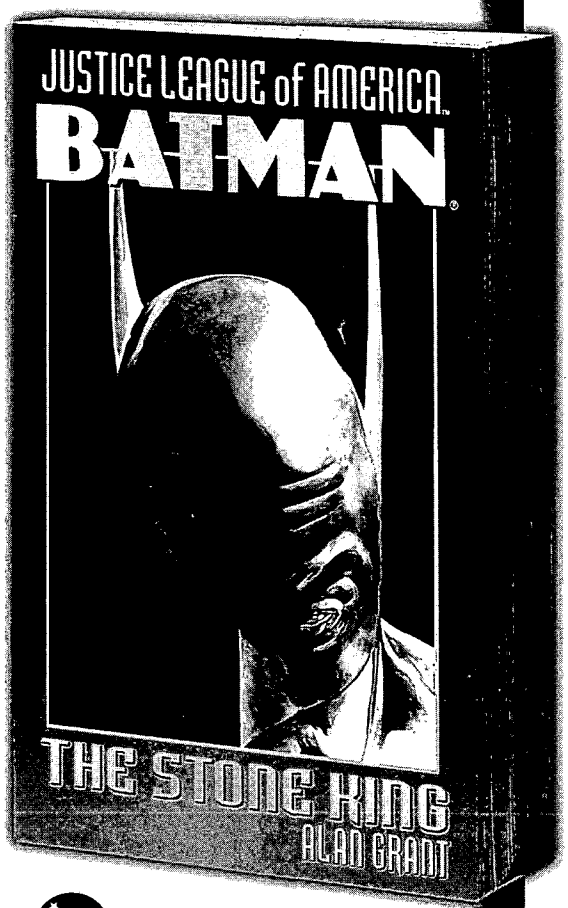

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